ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Vol. XXVII. No. 8.

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The East River Bridge bill, authorizing the Union Elevated Railway Co., of Brooklyn, to construct two bridges across that river, has passed the New York Assembly by a vote of 99 to 9. It is said to be the intention of the company to run their cars across the river and into New York, as far as the Bowery, connecting there with the Third Avenue Elevated road.

The railways entering Chicago are reported as discussing the construction of a belt line with which all are to connect, and the abandonment of lines within the city, as preferable to the proposed elevating of existing tracks. The Chicago & Northwestern is quoted as wildly estimating that to raise its present 190 miles of surface tracks in the city would cost $65,000,000, or about $340,000 per mile for a single track structure. There are nearly 1,500 miles of surface track now within the limits of Chicago. Under the proposed plan, passengers changing from one system to another would be taken on the belt line, but people bound for Chicago would have to depend on cable-cars or the elevated trains for transportation to their destination. If the railway property within the city is sold, it is believed that the amount realized would build the new depots and the belt line, pay all expenses of change and leave a surplus of about $10,000,000. The whole scheme may be a "bluff" arising from the present agitation against grade crossings.

A new building law is before the New York Legislature. It was prepared by the Superintendent of Buildings for New York and the Board of Fire Underwriters, American Institute of Architects, Architectural Iron Association, Mechanics' Trade Exchange and Real Estate Owners' and Builders' Association. Generally stated, the bill provides for thicker walls and 4 ins. of brick between floor beams. All buildings over five stories high must be fireproof, including dwellings. All owners of factories must within 90 days after the passage of the act employ competent experts to ascertain the weight imposed upon each floor; the expert and the owner must swear to this statement and forward it to the Superintendent of Buildings, who is authorized to remove unsafe weights. The proper floor load for dwelling houses is fixed at 70 lbs. per sq. ft.; for office buildings, 100 lbs., and for factories 150 lbs., and floors must be proportioned for these weights. Elevators in hotels must be enclosed by walls of brick or stone; and in all hotel buildings over four stories high a separate, continuous stairway is to be provided and inclosed with brick walls.

Another series of competitive brake tests has been in progress during the past week on the Lehigh Valley, which a short time ago ordered brakes for 2,000 new freight cars from the New York Air Brake Co. Two 50-car trains were tested, one equipped with the New York brake and the other with the Westinghouse. Both cars and brakes were new. The brake shoes were not worn to the wheels, which was rather unfortunate for making good records, although as fair for one competitor as for the other. The New York brake was tested on Tuesday; but the programme of tests laid down was not fully carried out, largely on account of frequent break-in-twos of the train; and as in several respects the results were indecisive, a second series of tests was made with this brake on Thursday. The train fitted with the Westinghouse brake was tested on Wednesday.

A complete block system is reported as being now in use on the Baltimore & Ohio R. R., between Baltimore and New York. The 32 mile gap between the Susquehanna River and Wilmington, Del., was closed this week. The B. & O. main line from Washington to Cumberland, Md., is also operated on the block system, excepting 10 miles near Annapolis Junction, and this gap is under contract. The blocks are not less than four miles apart, with shorter intervals near terminals.

We are informed that the Chicago, Burlington & Quincy R. R. has decided to use Westinghouse brakes on the 2,000 new cars for which the New York Air Brake Co.'s equipment was ordered some time ago. Whether the original order is canceled or is postponed until the New York Air Brake Co. can show satisfactory results with their triple valve is not stated.

Some extra long grades were used in double tracking the bridge at Newport, Lawrence Co., Pa., where the Pittsburg & Lake Erie R. R. crosses the Beaver River. After investigating the nature of the material which would be encountered in getting a foundation it was decided to build an entire new bridge of three spans of 103½ to 103¾ ft. each (b. w. to c. of pier) and to sink caissons for the foundations of the two piers. The character of the structure is a plate girder deck bridge. Work was begun on July 1, 1891, and the first span of girders was placed in position on Tuesday, Feb. 9. The depth of girders is 8 ft., thickness of web, $\frac{7}{16}$ in.; length, 103 ft.; camber, 1⅝ ins.; weight of a single girder, 50,060 lbs. The girders are transported on the same Pennsylvania Co.'s car which was used in taking the 12-in. gun to San Francisco for the "Monterey," as illustrated in our issue of Jan. 30. Mr. J. A. Atwood is the company's chief engineer; the Drake & Stratton Co. were contractors for the masonry; the Keystone Bridge Co., contractors for the steel superstructure, and Mr. Albert Lucius, of New York, engineer of bridges.

Street-car heating by steam pipes is being tested on the Third Avenue line in New York. Two 5-in. pipes run under the seats, and are connected by two cross pipes so as to form a complete circuit. Inside each 5-in. pipe is a smaller and shorter pipe nearly filled with brine. Under each large pipe are gas-burners consuming about 10 cu. ft. of gas per hour. Before leaving the depot the space about the inner pipe is charged with steam from a stationary boiler, the brine cylinder acting as a heat reservoir. Without the gas burners the heat thus supplied will be maintained for about three hours. The cost per car is said to be 25 cts. per day with the gas-burners and 10 cts. per day without.

The most serious railway accident of the week occurred Feb. 11 on the Toledo & Ohio Central at Pleasantville, O., near Bucyrus. A night freight train was derailed on a steep embankment and the engine, tender and 20 cars were wrecked. The engineer and fireman and one brakeman were killed. A Fitchburg freight train was wrecked on the same date at the Nashua River bridge, 10 miles east of Fitchburg, and 24 cars went into the river. The engine and four head cars passed over all right and the caboose at the rear of the train was left standing on the track. The accident is ascribed to the breaking of a truck on the fifth car. A temporary track was in place across the break 57 hours from the time the accident occurred.

A bridge accident, somewhat similar to the Moenchenstein catastrophe, happened at the iron bridge across the Optucha River between the stations Domnino and Tolotarewo on the Orel-Gryasi Railway in Russia, Dec. 23, 1891. According to the "Deutsche Bauzeitung," which gives fuller details than the cable transmitted, the train consisted of 18 freight-cars, baggage-car and 5 passenger-cars, made up in the order mentioned. Three of the latter went to the bottom of the river, which has a considerable depth at that place. The baggage-car fell against the abutment. There were 31 persons killed, but the number of injured is not given. The accident was caused by the derailment of the last freight car, owing to the breaking of a tire, while the train was still some 600 yds. from the bridge. Apparently the brakemen must have been negligent, or they would have managed to stop the train before it reached the structure. The accident could perhaps have been averted, if the bridge had been provided with a stronger floor system. The floor seems to have been an open one, having wooden ties without any planking between.

A peculiar accident occurred in the erecting shops of the Baldwin Locomotive Works on Feb. 16, by which two men were killed and a third was seriously injured. According to press reports, the men were repairing leaks in the boiler of the new compound locomotive which has been running in fast passenger service on the Philadelphia & Reading. The dome of the boiler was removed and before the noon hour the men applied a considerable quantity of benzine to bolt and rivet heads inside the boiler to soften the rust and scale. On resuming work one of the men got inside the boiler and a boiler maker's lamp was lowered to him. A considerable quantity of benzine vapor had probably accumulated in the boiler and mixed with air, for an explosion took place and the body of the man inside the boiler was fired like a projectile straight upward through the dome opening and lodged in the roof trusses overhead. The overhead electric crane had to be run underneath in order to reach him. Notwithstanding severe burns and other injuries, he lived after the accident for several hours. The workman who lowered the lamp into the boiler, and who was standing directly over the dome opening, is supposed to have been struck by the body of the man inside. He was also blown upward, struck one of the roof braces, and fell on a pile of iron plates. He died in a few minutes. The third workman was standing on top of the boiler between the cab and the dome. He was thrown to the ground and badly burned and bruised.

A test of the new high duty pumping engine built by H. R. Worthington for the water works of the city of Lowell, Mass., was made on Feb. 11 and 12 to determine whether the engine met the contract requirements for capacity and duty. The test was made in accordance with the standard code adopted by the American Society of Mechanical Engineers, and is the first test ever made by that method. The experts who conducted the test, Messrs. Geo. H. Barrus for the City of Lowell, and J. J. DeKinder for H. R. Worthington, were members of the committee of the society that formulated the standard code.

The engine has steam cylinders of 25 ins. and 50 ins. diameter, plungers of 27½ ins. diameter, and a nominal stroke of 36 ins. During the trial, however, the pump was run to the full contact stroke of 38 ins. The steam pressure is 95 lbs. and the approximate total lift is 175 ft. The total weight of the engine is 250,000 lbs. The contract required the engine to have a capacity of 10,000,000 galls. per 24 hours, and the duty required was 110,000,000 ft. lbs. of work per 1,000,000 heat units in the steam supplied. The duty test showed about 115,000,000 ft. lbs. per 1,000,000 heat units, and in the test for capacity which followed, the engine worked at the rate of 13,000,000 gallons per 24 hours, thus exceeding its contract capacity about 30% and its contract duty about 4½%.

A large number of invitations were sent out by the Lowell Water Board and about 200 visitors were present during the test, including most of the members of the New England Water-Works Association residing in the vicinity.

The Long Island Water Supply Co., of Brooklyn, is again being brought before the public. A bill providing for the purchase of the company's property has been prepared by Corporation Counsel A. F. Jenks and sent to Albany. According to the bill the property will be condemned; the price to be determined by commissioners appointed by the Supreme Court. It is stated that Mr. William Ziegler, who successfully defeated the proposed purchase by the city of this property for $1,250,000, a year ago, is opposed to the present bill, and has instructed his attorney to draw up a substitute. One of Mr. Ziegler's objections to the bill is that under it no citizen of Brooklyn has a right to take part in the appraisal proceedings, which, with other reasons, will lead, it is thought, to the placing of an excessive value upon the plant.

The consolidation of the Hyatt Pure Water Co., of Newark, N. J., the National Water Purifying Co., New York City, and the American Filter Co., Chicago, Ill., has just been officially announced. The new company has incorporated under the laws of New Jersey with a capital stock of $1,500,000, and with the name, the New York Filter Co. The full list of Directors is as follows: C. C. Worthington, John W. Hyatt, Henry P. Jones, A. C Westervelt, Peter Kinnear, W. M. Deutsch, Albert R. Leeds, Theodore F. Miller and John D. Harrison. The officers are: President, C. C. Worthington, of the Worthington Pump Co., New York City; Vice-President, John W. Hyatt, of the Hyatt Pure Water Co., Newark, N. J.; Treasurer, Henry P. Jones, Newark, N. J.; Secretary, John C. Symons, of the National Water Purifying Co., New York City. The new company acquires all the patents, about one hundred in number, of the old companies. Its office is at 115 Broadway, New York City.

The East River bridge bill, so long advocated by Dr. Ranney, of New York, has passed the New York Assembly. This bridge is to cross the East River in the vicinity of 90th St., New York, and Astoria, Long Island. Another bridge company, with $2,000,000 capital, was before the Assembly asking for authority to bridge the St. Lawrence River at Wolfe Island. The object is said to be to connect the New York Central and Canadian Pacific railway systems. The bill was passed.

THE LOW SERVICE EXTENSION OF THE WATER-WORKS OF ST. LOUIS, MO.

In our issues of April 18 and July 4, 1891, we published descriptions, accompanied by inset and other drawings, of the new settling basins and inlet tunnel and tower of the St. Louis Water Works. The accompanying views are reproduced from photogravures, which, excepting Fig. 4, appeared in the last annual report of Water Commissioner M. L. Holman. Fig. 4 is from Mr. Holman's report for the previous year. All the views were taken prior to April 1, 1891.

Fig. 1 shows the inlet tower in process of construction, with all plant in place, including the derrick, coffer dam and one of the cribs, at the left, to which the coffer dam was anchored.

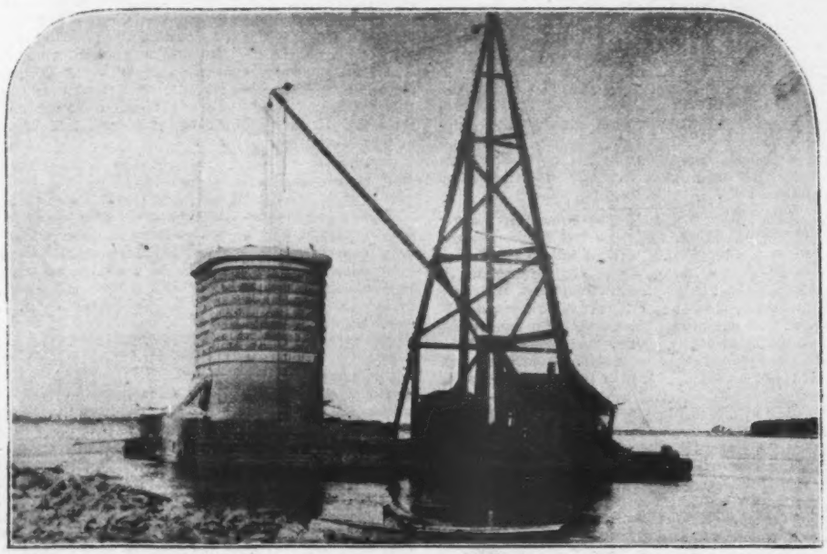


FIG. 1. THE INLET TOWER, ST. LOUIS WATER-WORKS LOW SERVICE EXTENSION; M. L. Holman, Water Commissioner.

Fig. 2 gives a general view of one end of the settling basins, including the whole of one basin. The character of the outer masonry walls is shown by Fig. 3, from which it will be seen that the masonry is rock faced with all joints dressed, laid random and brought up to two horizontal courses between the bottom and the top.

Figs. 4 and 5 show the method of crossing Maline Creek with the masonry aqueduct leading from the new settling reservoirs to the old distributing reservoirs at Bissell's Point. Fig. 4 shows the aqueduct bridge under construction, and Fig. 5 shows it completed. The artistic merits of this bridge are evident.

In our issue of April 26, 1890, two views were given of the Harlem arch culvert on this aqueduct line, the first showing the arch of the culvert nearly completed and with centering beneath it and the second showing the culvert after a freshet with the centering washed out. Only four stones were lacking in the crown of the arch, the arch being elliptical, with a 30-ft. span.

Further particulars regarding the extension may be had by referring to the articles mentioned above. Briefly it may be stated that water is to be taken from the Missouri River through an inlet tower and tunnel, pumped to settling basins and conducted by gravity some seven miles to the present distributing reservoirs.

THE DULUTH DRAWBRIDGE.

The harbor of Duluth, Minn., with an estimated capacity of 186 miles of slips is (by Duluth citizens at least) claimed to possess more natural advantages than any other harbor in the world, with one exception—the harbor of Sydney, Australia.

Duluth harbor is separated from Lake Superior by a narrow strip of land known as Minnesota Point, which juts out from the Duluth shore nearly parallel to the adjacent shore to a distance of about 7 miles, and at its extremity almost meets another similar point of land called Wisconsin Point.

Between the two points, and directly opposite the City of Superior is a narrow channel, the entrance to the harbor, which is otherwise naturally land-locked. The natural entrance to the harbor being thus situated, made it necessary for vessels to or from Duluth to make quite a detour from their direct course in order to enter the harbor.

A few years ago in order to obviate this, a canal 250 ft. wide was constructed across this point near the Duluth shore. This admitted vessels directly to the Duluth docks, but it also converted what had previously been a peninsula into an island, and much valuable dock room became deprived of communication with the main portion of the city except by boat.

As the city grew, and Minnesota Point became important for business purposes, this state of affairs became very undesirable, and the city authorities decided to build a bridge across the canal of such design that it could be quickly removed so as to leave the entire width of the canal clear, thus affording connection between Minnesota Point and the main portion of the city without interfering with the traffic of the canal.

Readers of Engineering News will probably remember a "Notice to Architects," which under date of Nov. 12 appeared among the advertisements of contracts during a portion of November and December of the past year, asking for competitive designs for a drawbridge for this place and offering a prize of $1,000 for the design which should be accepted. Designs to be submitted before two o'clock, Dec. 28. To those who applied for data a circular was sent, of which the following is a copy:

Competitors will be required to make their own investigations for plans and specifications; also to state the time required to open and close the draw during the most unfavorable weather, and the time required to complete the whole work. The present width of the canal is 250 ft., which is not to be diminished.

The bridge is to be 48 ft. in width over all and must accommodate one railroad track, two highways and two sidewalks. The bridge must be proportioned to carry in addition to its own weight a moving load composed of two consolidated 86-ton engines followed by a train load of 3,000 lbs. per lineal foot, a highway loading of two connected electric motors each weighing 15 tons when loaded for each roadway followed by a moving load of 500 lbs. per lineal foot for the entire length of roadways with special provisions for extreme wheel loads affecting the stringers and a sidewalk loading of 100 lbs per square foot of surface. Under this loading the strains are to be proportioned for the quality of steel used, varying from 10 000 lbs. per square inch for all live loads to 20,000 lbs. per square inch for all dead load.

Soft steel is to be used, 62,000 to 68,000 lbs. ultimate strength, with 36,000 lbs. per square inch elastic limit.

Competitors are cautioned that the term "Drawbridge" herein used refers to a drawbridge proper, or one that will draw back and leave the canal open and free for its entire width, and that plans submitted for a swing bridge will not be considered.

Following are some of the principal conditions of the location: The present roadway is 7 ft. above mean water level; the bridge to be 10 ft. above same. Height of quiet water varies about two feet. The swell runs to a height of about five feet. Water is from 25 ft. to 32 ft. deep. There is usually a strong, irregular current. The material under bottom of canal is fine sand. There is no means of shutting off the water. In spring and summer canal is often obstructed by rafts.

There were 16 designs submitted. The following brief synopsis of the designs is an abstract from the "Duluth Tribune" of Dec. 29, 1891:

Mr. J. A. L. Waddell, of Kansas City, submitted a plan that while not conforming to conditions drew out many favorable comments. He submitted another plan, however, meeting the conditions with false approaches at each end sliding sideways, with the main bridge separating in the middle and sliding back into the vacated approach pockets. Cost, including approaches, $154,000. Mr. Waddell's plan No. 1 provided for two towers furnished with 15 ft. built steel pulleys, arranged to lift the bridge vertically by aid of counterweights; cost, $105,000, with no land needed for special approaches.

Messrs. Oscar Sanne and W. H. Finley, of Milwaukee, submitted plans for a double draw, to cost $140,000. Mr. W. L. Stebbings, Engineer of the Chicago & Northwestern Ry., proposed a pontoon draw, to cost $135,000. Mr. F. C. McMath, of Detroit, sent a plan for a sliding-draw to cost $179,000; Mr. J. A. McNicol, Providence, R. I., a single draw to cost $125,000; Mr. B. F. La Rue, Jackson, Mich., proposed a single-span in the form of a floor supported upon and operated by a steam tug underneath the free end of the bridge, the other end being pivoted, cost, $108,000. John A. Roebling & Sons provided for a double lift, with two steel towers, 135 ft. high, from which each half span is lifted by cables, to cost $40,000 exclusive of foundations. Mr. A. S. Cooper, of West Superior, proposed two plans, a swing

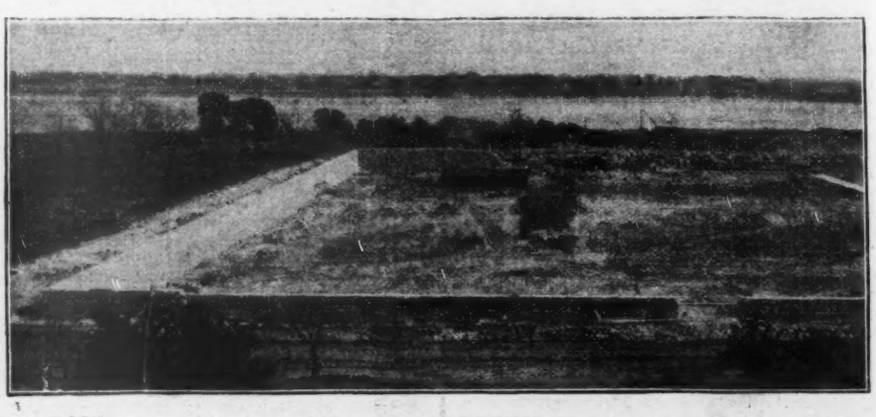


FIG. 2. SETTLING BASIN NO. 3.

and a lift bridge, to cost $78,000. Mr. F. C. H. Arentz, of Milwaukee, submitted a plan for a single draw, to cost $300,000. Mr. H. Breen, of Chicago, proposed a draw operated on rollers on the bottom of the canal, to cost $160,000. Mr. John N. Ostrom, New York, had a plan for a double-lift with a pier midway in the bottom of the canal, on which rest hinged supports for the free end of the bridge when closed. The Strom-Lindman-Hilliker Tunnel Co., of Minneapolis, submitted a tunnel design to cost $500,000 for a double tunnel. Mr. Wm. Sooy Smith, of New York, designed a double draw, rolling back, for $221,000. Mr. E. B. Jennings, Springfield, Mass., had a plan for a double swing bridge, to cost $17,000. The prize of $1,000 was finally awarded to Messrs. Arentz & Sangdhal, of Millwaukee, for a pull-back drawbridge, which is apparently not included among those described by the "Tribune."

PROPOSED FLUSHING TIDAL RESERVOIR FOR THE IMPROVEMENT OF WILMINGTON HARBOR, DELAWARE.

The harbor of Wilmington, Del., lies about 1½ miles from the bank of the Delaware River, and access to it is by the Christiana and Brandywine creeks, which unite about one mile from the main river. At the present time there is a channel 21,000 ft. long extending through the shoals of the Delaware River and up the Christiana Creek to Wilmington. This channel is from 8 to 15 ft. deep at mean low tide, and from 50 to 150 ft. wide. The plan of improvement, adopted in 1883, contemplates a dredged channel 15 ft. deep and 150 ft. wide for a distance of about 4 miles; the channel to be maintained over the outer bar by a jetty extending out into the Delaware. This jetty is now 1,800 ft. long.

Under present conditions the tidal force alone is not sufficiently powerful to maintain permanently even the existing channel, much less the larger one contemplated. Careful investigation shows that the improved section would require, for the prevention of shoaling, an increase of tidal force of 7% in the lower, 50% in the middle and 84% in the upper reach. The material now deposited in the channel, amounting to 120,000 to 150,000 cu. yds. per annum, comes from the backwater carried in from the Delaware by the flood currents, from scour and from drainage.

A commission on the improvement of this harbor was appointed in Sept., 1890, and reported June 18, 1891, the commission being made up of Col. D. C. Houston and Major C. W. Raymond, U. S. Engineers, and Mr. L. Y. Schermerhorn, civil engineer. After discussing the difficulties encountered, due to low tidal force and the deposit of sediment and sewage in the channel, the commission recommends under certain conditions the increase of tidal scour by the formation of an artificial tidal basin above the reach to be improved.

This basin could be made by dredging in marsh land, now about 3 ft. above mean low water, and a bottom 6 ft. below low water would give sufficient capacity with an area of about 200 acres. The application of this method would require the construction of a movable dam or weir across the river and directly above the reach to be improved. This dam would have to be arranged so as to admit freely the passage of the flood volume, and then be closed at high tide, impounding the flood tide volume above it. After the tidal volume below the dam had partly passed out the impounded water would be released and by its flushing action sweep out the sedimentary matter brought in by the flood tide or by drainage.

In the case in question it is calculated that the volume of tidal flow passing above the site of the dam, augmented by the flow from above, is about 48,000,000 cu. ft. To produce a mean velocity of discharge of 1½ ft. per second, as needed for the 15 ft. channel, would require the addition of 15,000,000 cu. ft. per hour from the impounding reservoir; and the reservoir could supply this for about 3 hours. To maintain a velocity of 2 ft. per second would require the addition of 25,000,000 cu. ft. per hour, which could be supplied for nearly 2 hours.

The plan considered by the commission involves the construction of about 300 lin. ft. of movable dam on the Camere system, with a lock 150 ft. long and 30 ft. wide for the passage of small vessels using the river above the dam. The estimated cost of the structure is $200,000.

The commission recommends that the 15-ft. channel be first dredged out, at an estimated cost of $142,000, and that then the rate of shoaling at various points be carefully determined for at least one year. From these observations it can then be decided whether it is more economical to maintain the channel by dredging or by the construction of the tidal basin.

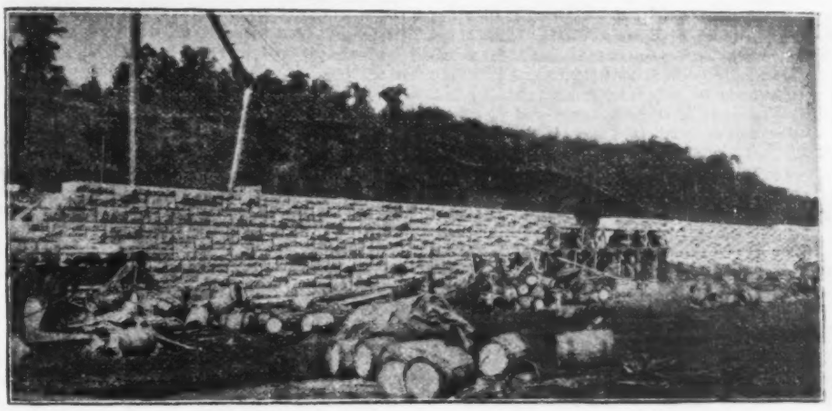


FIG. 3. INTERIOR FACE OF WALL OF SETTLING BASIN.

FIG. 4. MALINE CREEK BRIDGE UNDER CONSTRUCTION, SHOWING AQUEDUCT.

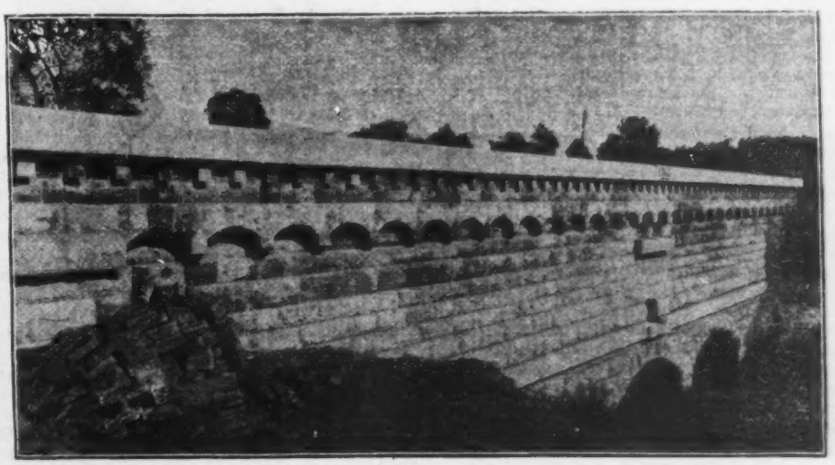


FIG. 5. MALINE CREEK BRIDGE COMPLETED.

A new kind of paving is being tested at Frankfort on the Main, says the "Zeitschrift des Oesterreichischen Ingenieur-und Architekten Vereines." Upon a foundation of concrete iron gratings, about 1⅛ ins. in height and consisting of thin flat strips of iron, easily put together, are placed and their spaces or meshes filled with melted asphalt-mastic. It is asserted that this grating will greatly lessen the disagreeable softening and flowage of the asphalt during the heat of the summer and will also give the horses a more secure footing in wet weather. The cost of the pavement is rather high: $4.50 to $5 per sq. m. (1.196 sq. yds.)

THE TACOMA SHOPS OF THE NORTHERN PACIFIC R. R.

[With Inset.]

The Northern Pacific R. R. Co. has established very complete repair and manufacturing shops about three miles south of Tacoma, Wash. These shops were erected by A. McMullen & Co. It is the intention of the railway company to build and rebuild a large portion of its freight equipment at this point, largely on account of the abundance and cheapness of timber, and especially red and yellow fir. We are indebted to Mr. J. W. Kendrick, Chief Engineer, for blue prints and notes from which the following description and cuts were prepared.

The general arrangement of the shops is shown in Fig. 1. The plant covers an area of about 20 acres and there will be about nine miles of working track when everything is completed. The shops are all

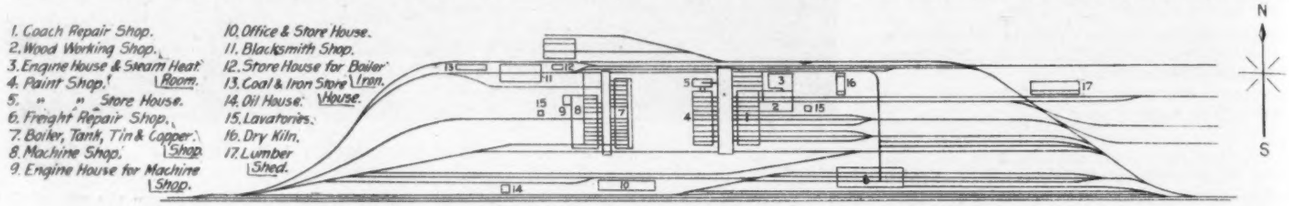

1. Coach Repair Shop.
2. Wood Working Shop.
3. Engine House & Steam Heat
4. Paint Shop. Room.
5. " " Store House.
6. Freight Repair Shop.
7. Boiler, Tank, Tin & Copper. Shop.
8. Machine Shop. Shop.
9. Engine House for Machine Shop.
10. Office & Store House.
11. Blacksmith Shop.
12. Store House for Boiler
13. Coal & Iron Store Iron.
14. Oil House. House.
15. Lavatories.
16. Dry Kiln.
17. Lumber Shed.
N
S

FIG. 1. GENERAL PLAN OF YARD AND SHOPS, NORTHERN PACIFIC R. R., AT TACOMA, WASH.

heated by steam, on the Sturtevant system, and lighted by electricity, the apparatus being furnished by the Edison General Electric Co. It is expected that about 500 men will be regularly employed. The machinery was furnished by Manning, Maxwell & Moore, of New York, and the Edison electric transfer table by the Industrial Works, Bay City, Mich.

The grounds are graded to an elevation which is generally 16 ins. below the top of the finished floors. The foundations are concrete and masonry. Specifications were originally prepared for foundations on piles, with the expectation that the buildings would be located on a different site from that finally adopted. The piles were to be of red fir, not less than 9 ins. in diameter at the small end.

The works include the following structures:

Coach repair and erecting shop, 2 stories; cabinet and upholstering departments in second story, 100 by 243 ft.; wood working shop, 90 by 152 ft.; engine house and steam heating room, 42 by 74 ft.; boiler house, 42 by 76 ft.; coal house, shaving and dust tower, 19 by 76 ft.; chimney (6 ft. flue), height 150 ft.; paint shop, 90 by 242 ft.; paint shop storehouse (2 stories), 35 by 90 ft.; freight repair shop, 90 by 302 ft.; two lavatories, 26 by 42 ft.; double dry kiln, 40 by 72 ft.; machine shop, 120 by 244 ft.; engine house for machine shop, 40 by 40 ft.; boiler, tank, tin and copper shop, 80 by 321 ft.; blacksmith shop, 80 by 192 ft.; coal and iron storehouse, 28 by 150 ft.; storehouse for boiler iron, 25 by 50 ft.; office and storehouse, 43 by 156 ft.; oil house, 43 by 60 ft.; round house, first class, 22 stalls; turntable, length, 65 ft.; two water tanks, each 49,000 gallons; ash pit, length, 100 ft.; sand house, 25 by 42 ft.; coaling station, first class, 47 by 346 ft.; dry lumber shed, 40 by 225 ft.

The coach and woodworking shops, engine and boiler houses are closely connected, and all the woodworking machines have pipes through which the shavings and sawdust are drawn by an exhaust fan. In the northwest corner of the engine house is a shaving and dust tower of simple and inexpensive design. The concrete floor in the basement is made of concrete "A" (see below), and finished with a ½-in. coat of cement mortar. The foundation walls of the dust flue are laid in cement mortar and plastered inside. The inside portion of the brick walls are laid in cement mortar. The floor of the shaving room is made of ⅜-in. tank iron, with lap joints riveted with ⅝-in. rivets at 6 ins. pitch and fastened to the rails supporting the floor every 12 ins. The cistern in front of the dust flue is laid in cement mortar and plastered water tight. The boiler room, coal room, and shaving tower are shown in Figs. 2, 3, 4 and 5.

The specifications for the concrete used in the buildings read as follows:

Concrete "A."—The ingredients to be English Portland cement, clean, sharp sand and broken stone, any piece of which shall pass through a 2½-in. ring. These ingredients will be used in the proportion of 1 part of cement to 4 parts of sand, to 8 parts of broken stone. Sand and cement must be thoroughly mixed while dry, spread out in a bed and the broken stone placed on top of it. Wet the bed thus formed by sprinkling with water and mix thoroughly until every piece of stone is covered with mortar; wheel to pit, and place in layers, tamping until the water flushes to the surface. Finish all top surfaces level.

Concrete "B."—The ingredients for the mortar are the same as specified for concrete "A," and are to be mixed and deposited in trenches where required, when stones of miscellaneous sizes are thrown in and tamped until they are entirely surrounded by mortar; top surfaces to be left level.

Concrete "A" will in general be used for the foundation of walls, if used in connection with piling. Concrete "B" will be used for foundations where no piling will be required.

In these, as in other buildings, the roofing material is generally No. 26 sheet steel, laid with a standing seam and finished with cornices of the same material. Where corrugated metal is used, it is of No. 26 gage on boarding, or No. 24 gage when not so supported.

The machine foundations in the woodworking shop are built of rubble in cement mortar, and finished with surfaced fir timbers, bedded in mortar at the floor level. Among the tools used here, are a four-roll double cylinder Pacific planer and matcher; planing on both sides a piece 24 ins. wide and 6 ins. thick, and matching pieces 16 ins. wide; an improved Daniels' planer, taking stock 20 ft. long and 24 ins. or more wide; a large endless bed surfacer, planing 26 by 12 ins.; an extra large size molder, cutting 12 ins. wide and 15 ins. deep; and a number of the latest types of molding, joining and shaping tools, lathes and saws. In the coach shop are 10 transverse tracks, 2 of which run through the woodworking shop also. The drop table for locomotives is raised and lowered rapidly by means of screws.

The general details of the freight repair shop are

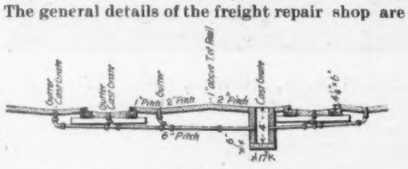


Fig. 8. Section of Floor of Paint Shop.

shown in Fig. 6. There are three longitudinal tracks and the same number of turntables on a single cross track. The water supply of this shop is rather interesting. A 6-in. cast iron pipe extends along the building and is provided with four 2½-in. galvanized iron branches which terminate with hose valves 6 ft. above the floor and properly fastened to the walls. Three feet from the floor on each of these stand pipes is a T with a ¾-in. brass hose bibb.

The machine shop has stalls for 11 engines, one being over a drop pit. The cross section, Fig. 7, shows clearly the general arrangement. In the machine shop are a number of the best tools for engine work, among them a 79-in. Pond double wheel lathe, Pond steel-tire car wheel lathes, several engine lathes by the same builders, and also of the Reed pattern, a number of Pond and Pedrick & Ayer planers, Brown & Sharpe milling machines, beside the usual boring mills, drills, and other machine tools.

The boiler, tank, tin and copper shop, which is 323 by 82 ft. in size, has three divisions: a boiler shop with eight tracks, a tin and copper shop with a single track, and a tank shop with four tracks. The floor of the boiler shop is made of cinders, the others have ordinary 3-in. plank floors, resting on 4 by 6-in. mud sills.

The paint shop has ten tracks approximately 90 ft. long, and is connected with a storehouse 92 by 37 ft. in size. The floor of the paint shop is made of concrete as shown in Fig. 8. A 10 in. bed of rammed sand or gravel was laid, and on this was put a 3½-in. layer of concrete, made of 4 parts of sand, 4 of fine gravel, and 1 of cement. On this was placed a layer, 2 ins. thick, made of 5 parts of coarse sand to 1 of Portland cement. The whole was finished off with a ¼-in. coat of equal parts of Portland cement and sand. The track is carried on metal cross ties, to which longitudinal stringers of red fir are fastened with ⅝-in. bolts. The details of the floor drainage are shown in the cut.

The engine and boiler plant consists of an 18 × 42-in. Reynolds-Corliss engine having a flywheel 18 ft. × 29 ins. and weighing 16,000 lbs.; a Reynolds-Corliss engine, 18 × 42 ins., with a flywheel 16 ft. × 29 ins. and weighing 15,000 lbs.; six Babcock & Wilcox boilers of 104 HP. each, arranged in three batteries of two boilers each; two Armington & Sims engines, cylinders, 9½ × 12 ins., flywheels 47 ins. × 10½ ins., 1 lutions per minute.

The floor of the engine shop and steam heating room is made of 2-in. surfaced lumber, spiked to 4 × 4-in. sills, bedded in sand or gravel. The second floor is made of 3 × 1-in. yellow fir and finished with two coats of oil. A layer of No. 2 tarred roofing felt is placed between the two floors. The engine foundation is of range work in cement mortar. The boiler room is floored with concrete, like the paint shop, and the boilers are set in brick in the regular manner.

The heating of the shops is entirely done by steam, as before mentioned. The woodworking and coach shops and engine room are heated by low pressure steam, the water of condensation being returned to a receiving tank in the boiler room, whence it is pumped back into the boilers. The dry kiln is heated by high pressure steam and the water of condensation returned to the receiving tank. The paint and freight repair shops, paint shop stock room, roundhouse, office and storehouse, oil house and lavatories have apparatus capable of running at high or low pressure, with water of condensation returned to the receiving tank, except in the case of the oil house. Live steam pipes, separate from the heating pipes, are run from the boilers to the engines in the boiler and machine shops, with live steam branches to the pits and to the steam hammers in the blacksmith shop, where a steam storage tank is also provided in connection with the hammers, which exhaust into the open air. The exhaust from the engines in the machine and boiler shops is utilized for heating these buildings; in this case the water of condensation is not returned to the boilers.

The buildings are piped so that the following temperatures can be maintained when the outside temperature is zero: Woodworking shop, coach shop, boiler shop, and machine shop, 55°; lavatories, oil house and freight repair shop, 50°; paint shop, stock room and roundhouse, 60°; office and storehouse, 70°.

All high pressure steam pipes are insulated with asbestos, hair felting and manila paper, covered with 8-oz. duck. Steam pipes outside buildings are carried in wooden boxes filled with mineral wool, at least 6 ins. all round the pipes. The boxes are perfectly water tight. When carried overhead they are covered on top with sheet iron or tin; if underground, they are coated with tar. At these shops there are two transfer tables for the handling and transfer of locomotives and cars. The tables are each operated entirely by electricity, a portion of the electric lighting apparatus being advantageous-

ly employed during the day in generating the current for this purpose. These tables are respectively 40 and 70 ft. long, although the shorter is of the greater capacity, designed to carry a load of 148,500 lbs., distributed over its entire length, while the design of the longer is for a load of 93,310 lbs. with an extreme wheel base of 64 ft. The smaller table is between the boiler and machine shops, and is composed of 4 panels of equal size, and travels upon 10 wheels, the centers of the 5 pit rails being 9 ft. 4½ ins. apart. The longer table is between the car and paint shops. It has 6 panels and 14 wheels, and the distance between the centers of the seven rails in the pit is 11 ft. 3 in. Both tables have a travel of about 300 ft.

In construction the framework of each of these transfer tables consists of longitudinal and transverse steel I-beams of depth and weight suited to the capacity required, which with heavy angles and the top and bottom bracing necessary to rigidity in all directions, are thoroughly riveted together. The strength and stiffness possessed by the modern transfer table because of the length which it has attained in a majority of cases and the capacity

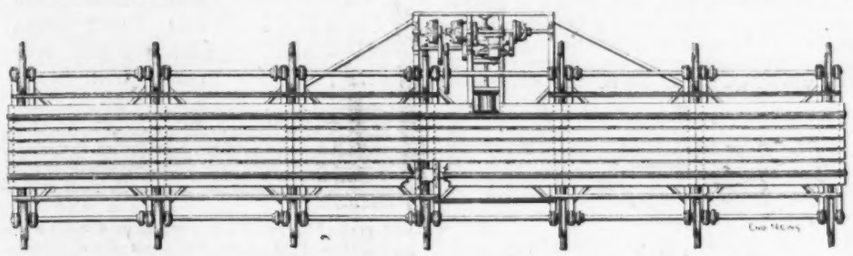


FIG. 9. PLAN OF TRANSFER TABLE FOR NORTHERN PACIFIC R. R. AT TACOMA.

required, are important factors in its successful use, and the design here employed is intended to cover all that is necessary in this direction. This frame work is suspended from the running gearing, utilizing every inch of space and greatly lessening the depth of pit required, which is obviously an advantage, and again its dimensions are such as to afford sufficient width between the wheels, which project above its surface, for any locomotive, car or other railway appliance. With each of these tables the cross beams at a central point are extended beyond the remaining width and afford proper support for the electric motors and operating mechanism. The electrical equipment for each table consists of a 15-HP. Edison motor, geared to one axle of the table, with four reductions.

In a general way the further description of one of these transfer tables will apply to both, as aside from the main framework, the remaining parts are largely identical. The wheels are 36 ins. in diameter, a size which adds to the ease and rapidity of their movement. They are of special make, have chilled flat treads, and are machined accurately to the same diameters. All of these wheels upon the same side of the table are attached to a single shaft running through from end to end continuously and connected in sections by means of couplings, so that any wheel or section can readily be removed for repairs without disturbing the remainder. With this form of construction these wheels revolve together, the motive power is applied directly to all of those on one side of the table and the whole is materially stiffened and strengthened. At regular intervals, where the framework is suspended, are bearings and boxes upon each side of every wheel, these boxes being provided with suitable chambers for oil and waste, so that all bearings are properly lubricated.

For pulling the load on or off the table, a drum is provided which is operated in connection with the propelling power. This drum coils a sufficient amount of rope to perform its work conveniently and quickly. The power is communicated through an electric motor of 15 HP., the system of gearing, friction clutches and connections for all movements being perfectly adapted to the service required. These tables are capable of attaining a speed of 250 ft. per minute with light loads, and 90 ft. per minute when loaded to their maximum capacity. The speed of the hauling attachment is 90 ft. per minute. A friction brake controls the motion of the table, and enables the operator to stop it at his will and at precise points. The overhead system of wiring is used, with double trolleys, the trolley line being supported outside the pit, and running lengthwise of and just over its edge. The trolley and arm are carried at the end of the table.

The Industrial Works, Bay City, Mich., designed and built these tables, and also furnished the complete electrical equipment for their operation. The general arrangement is shown on the plan Fig. 9; and the sketch Fig. 10 shows a very similar table, built at the same works for the Union Pacific Railway. This table is 70 ft. long, and has seven panels. It is of much greater capacity than either of the tables at Tacoma, and has a somewhat different housing over the motor equipment.

LEGAL DECISIONS OF INTEREST TO ENGINEERS.

Assignment of Municipal Payments by Contractor.

A contractor with a city gave a bank an order directing the city to deliver to it all warrants on account of the contractor's work. The contractor then gave written orders on the bank to pay certain sums to certain of his creditors. These were presented before the warrants were delivered to it and placed on the file under a parole agreement between the bank, the contractor and the payees of the orders that the bank, after reimbursing itself for the advances to the contractor out of the proceeds of the warrants when collected, should apply the remainder in payment of the orders in the order in which they were presented, unless restrained by legal proceedings. Under the agreement the orders were an equitable assignment of the fund to be received on the warrants, and therefore the bank could not be charged with such fund as garnishee of the contractor in favor of a mere creditor of his.—McDaniel v. Maxwell, Sup. Ct. of Ore., 27 Pac. Rep., 952.

Validity of Passenger Train Regulations.

In an action against a railway company for damages for carrying plaintiff past a station, the evidence was that the company had the day before put into effect a new time card, by which its night train each way was no longer scheduled to stop at the said station as theretofore; that two day trains, however, were unaffected by the change, and that these latter gave ample accommodations for the business at that and other small points along the line. Plaintiff testified that the agent told him when he bought his ticket that the train he was intending to take would not stop at his station, and that the conductor told him the same thing before it started, and requested him to get off, which he refused to do. The conductor remarked to him that he "was hunting a lawsuit." The train carried him past his station to one beyond, where he boarded the returning train, although informed that it made no

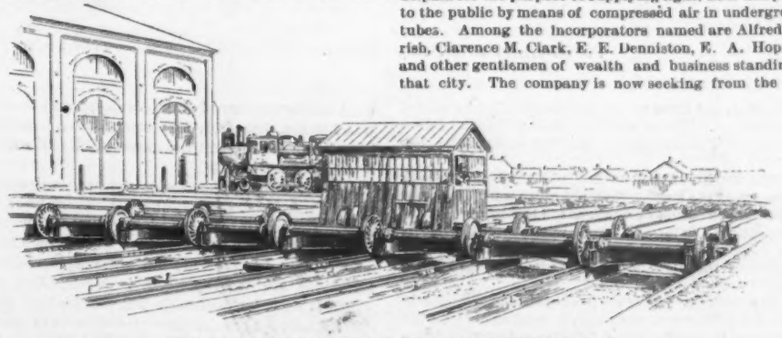


FIG. 10. TRANSFER TABLE FOR UNION PACIFIC R. R.

stop, and was again carried past to the point from which he started. Notice of change was posted at the station. The regulation that one train each way should not stop at all stations was reasonable, and, inasmuch as it had been published and plaintiff was informed of it, he was not entitled to recover.—Texas & P. Ry. Co. v. White, Ct. of Appeals of Texas, 17 S. W. Rep., 418.

Engineers' Classification of Work by Agreement.

Defendants were contractors for certain construction on a railway, and contracted with plaintiff to do a portion of the work. Plaintiff was to receive 25 cents per cubic yard for removing loose rock, and 75 cents for solid rock, the classification to be made by the chief engineer of the railway, or by one appointed by him for that purpose. Plaintiff commenced work, and then notified the local engineer in charge of the work that unless the job were classified as solid rock he would abandon it; whereupon the engineer so classified it, and plaintiff completed his contract. A member of defendant firm was present during the work, and knew of the classification shortly after it was made, and told plaintiff it was all right. Defendants were liable on such classification.—Ricker v. Collins, Sup. Ct. of Texas, 17 S. W. Rep., 379.

Proof of Fires from Engine Sparks.

The mere fact that property is fired by sparks thrown from the stack of a locomotive engine is not in itself evidence of negligence, unless it appears that the spark-arrester was defective, or that the company had not adopted the most approved pattern. Where property is fired by sparks from a locomotive engine, and the proof shows that it might have been fired by sparks either from an unknown engine or from one of several engines, some of which were unknown, it is competent to show that many of the engines threw sparks, and that numerous fires had been kindled on that part of the line; but such proof should be confined exclusively to occurrences at or about the time of the fires, with such reasonable latitude as to time as to render the proof practicable. Henderson, Hull & Co., Ltd., v. Philadelphia & R. Ry. Co., 22 At. Rep., 851.

Limitation of Action for Damages by Establishing Street Grade.

Under the provision of the Pennsylvania constitution giving a right of compensation for property injured, but not actually taken, in the construction or enlargement of municipal works, there is no right of action for the establishment on a city plan of a street grade, but the right of action is for the actual cutting of the street to correspond with the grade so established, and therefore the statute begins to run only from such time.—(Ogden v. City of Phila., Supr. Ct. Pa., 22 At. Rep., 694.)

Liability of Railway for Fence and Cattle-Guards.

Where, in a suit against a railway company for killing stock on the track, the defense is that the company was not bound to maintain a fence at the point where the stock got on the track, but it is shown in the evidence that this point was not within the side track limits, and it does not appear clearly that a fence and cattle guard at that point would have endangered the lives of the employees of the road in switching, a verdict for plaintiff will not be disturbed, as the burden is on the defendant to show that it could not safely maintain a fence and cattle guard at the point in question.—(Ind'polis & D. Ry. Co. v. Clay, App. Ct. Ind. 28 N. E. Rep., 567.)

Duty of Company to Provide Rules.

While a servant assumes the risks ordinarily incident to his employment, and all open visible risks, including the negligence of a fellow-servant, yet he has a right to presume that the master will exercise due care for his safety, by providing, when necessary, all needful rules for the conduct of its business, or such precautionary regulations as will not needlessly expose him to risks not necessarily resulting from his occupation. Failure to provide such rules, or to adopt such precautionary measures, as were needful to regulate or oversee the running of locomotives upon the tracks and switches of the yard, and as would render the place of employment upon cars upon the tracks reasonably safe, is negligence on the part of the company.—Wild v. Oregon Short Line & U. N. Ry. Co., Sup. Ct of Ore., 27 Pac. Rep., 954.

Construction of Sewer Contract.

One Murphy constructed a sewer for the city of O., the contract price being the sum of $28,045.40. Payments were made from time to time, so that when the work was accepted on Oct. 3, 1888, there remained due the contractor the sum of $7,551.50, and 5% of the total contract price, viz., $1,402.27, to be held six months. The principal, without interest, was afterward paid. In the absence of a contract to the contrary, the contract price, less the 5%, was due upon the acceptance of the work, and that the contractor was entitled to 7% interest upon the amount due, until it was paid. Likewise that he was entitled to interest on the 5% fund held in reserve after the expiration of six months from Oct. 3, 1888, until it was paid.—Murphy v. City of Omaha, Sup. Ct. of Neb., 50 N. W., Rep., 265.

The Pneumatic Power Co. has been organized in Philadelphia for the purpose of supplying light, heat and power to the public by means of compressed air in underground tubes. Among the incorporators named are Alfred Parrish, Clarence M. Clark, E. E. Denniston, E. A. Hopkins, and other gentlemen of wealth and business standing in that city. The company is now seeking from the City Councils authority to lay pipes in important business thoroughfares.

Connected with the Pneumatic Power Co. is the Philadelphia Rapid Transit Co., which proposes to use compressed air in propelling street cars, probably first on the Ridge avenue line. Grooved rails will be used.

Two Harlem bridge bills are before the Legislature of New York. The first authorizes New York City to appropriate $1,000,000 for a drawbridge across the Harlem at 145th St., and the second authorizes a drawbridge, to cost $1,250,000, across the river at the north end of First Avenue.

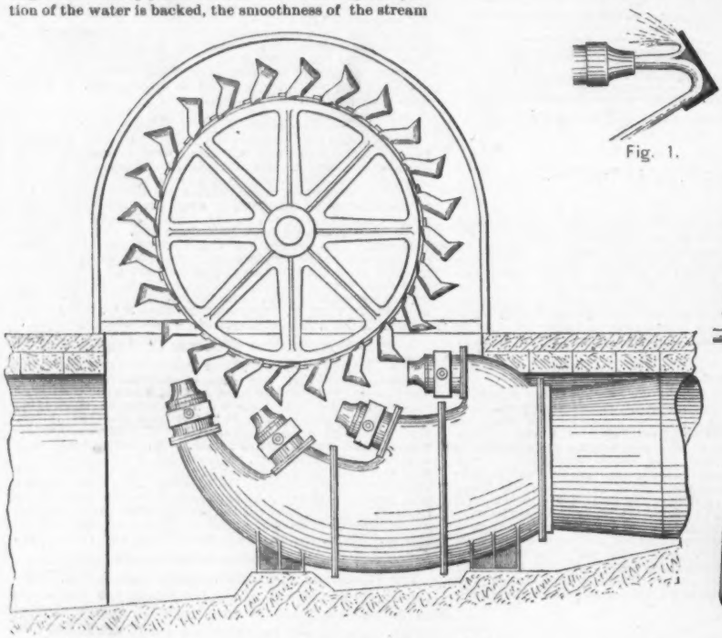
THE PELTON WATER-WHEEL.

In a paper upon "Tangential Water-Wheels" Mr. Ross E. Browne, well known as a civil and mining engineer and as an author, thus practically outlines the principles upon which this well known water-wheel is constructed:

The function of a water-wheel, operated by a jet of water escaping from a nozzle, is to convert the energy of the jet, due to its velocity, into useful work. In order ot utilize this energy fully the wheel bucket, after catching the jet, must bring it to rest before discharging it, without inducing turbulence or agitation of the particles.

It is plain that this cannot be fully effected, and that unavoidable difficulties necessitate the loss of a portion of the energy. The principal losses occur as follows: First, in sharp or angular diversion of the jet in entering, or in its course through the bucket, causing impact, or the conversion of a portion of the energy into heat instead of useful work. Second, in the so-called frictional resistance offered to the motion of the water by the wetted surfaces of the buckets, causing also the conversion of a portion of the energy into heat instead of useful work. Third, in the velocity of the water, as it leaves the bucket, representing energy which has not been converted into work.

Hence, in seeking a high efficiency, there are presented the following considerations: 1st. The bucket surface at the entrance should be approximately parallel to the relative course of the jet, and the bucket should be curved in such a manner as to avoid sharp angular deflection of the stream. If, for example, a jet strikes a surface at an angle and is sharply deflected, as shown in Fig. 1, a portion of the water is backed, the smoothness of the stream is disturbed, and there results considerable loss by impact and otherwise. The entrance and deflection in the Pelton bucket are such as to avoid these losses in the main. See Fig. 2.



Pelton Wheel With Multiple Nozzle.

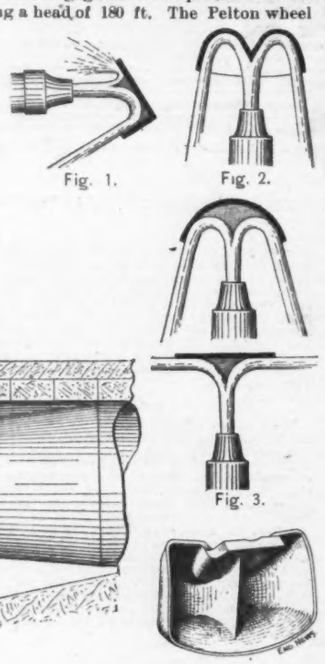


Fig. 1. Fig. 2. Fig. 3.

The Pelton Bucket.

2d. The number of buckets should be small, and the path of the jet in the bucket short; in other words, the total wetted surface should be small, as the loss by friction will be proportional to this. A small number of buckets is made possible by applying the jet tangentially to the periphery of the wheel, as provided in the construction of the Pelton.

3d. The discharge end of the bucket should be as nearly tangential to the wheel periphery, as compatible with the clearance of the bucket which follows; and great differences of velocity in the parts of the escaping water should be avoided. In order to bring the water to rest at the discharge end of the bucket, it is easily shown, mathematically, that the velocity of the bucket should be one-half the velocity of the jet.

A bucket, such as shown in Fig. 3, will cause the heaping of more or less dead or turbulent water at the point indicated by dark shading. This dead water is subsequently thrown from the wheel with considerable velocity, and represents a large loss of energy. The introduction of the wedge in the Pelton bucket—see Fig. 2—is an efficient means of avoiding this loss.

A wheel of the form of the Pelton conforms closely in construction to each of these requirements. The entrance and deflection of the jet is smooth and induces very little shock. The discharge from the wheel, when running at proper speed, is almost entirely at the bottom of the wheel, and the amount of water carried over is small, *i. e.*, the loss due to the energy of the discharged water is unusually small.

Both feed and discharge are practically tangential. The tangential feed admits of the design with a minimum number of buckets—the bucket is short—in fact, the entire wetted surface is small, and an important advantage is gained over the partial turbines with inner feed. The bucket is open and the rapid passage of the jet is comparatively free.

Mr. Browne tested a Pelton wheel, constructed in the workshop of the University of California and thus not wholly conforming with the standards of the company, with the following results: Diameter of wheel 15 ins., width of bucket 1.5 ins., head 50 ft. The efficiencies under this head were—With a $\frac{7}{16}$ in. nozzle, 82.6%; with a $\frac{5}{8}$ in. nozzle, 82.5%. Mr. Browne says, however, that the bucket used was too small to do full justice to the wheel, owing to the difficulty of shaping the curves accurately.

In a test made by the proprietors of the Idaho mine, near Grass Valley, Cal., the dimensions and results were as follows: Main supply pipe 22 ins. diameter, 6,900 ft. long, with a head of 386½ ft. above center of nozzle. The loss by friction in the pipe was 1.8 ft., reducing the effective head to 384.7 ft., and the Bourdon gage showed a pressure of 165 lbs., indicating a head of 180 ft. The Pelton wheel used in the test was 6 ft. in diameter and the nozzle was 1.89 ins. diameter. The work done was measured by a Prony brake, and the mean of 13 tests showed a useful effect of 87.3%.

In May, 1891, another series of tests were conducted by Prof. M. E. Cooley, of the University of Michigan. The result of this test is given as follows.

Comparisons of Various Water Motors.

Made in the Mechanical Department of the University of Michigan under the direction of Prof. M. E. Cooley.

Name of Motors.	A.	B.	Pelton.
Catalogue Number or Size	No. 12.	22 ins.	No. 2, 12 ins.
Size of Nozzle	¼ to ⅜ in.	¼ to ⅜ in.	¼ to ½ in.
Style of Nozzle	Conical, with cylindrical tip.	Conical, with cylindrical tip.	Conical, with cylindrical tip.
List Price with Pulley.	$125·00	$85.00	$60.00
Rated Horse Power	50 to 100 lbs. pressure 2 to 5	75 to 150 lbs. pressure 3 to 4½	At 100 lbs. 4.9
Comparison with ⅜ in. Nozzle under 100 lbs Pressure.			
Theoretical Spouting Velocity in feet per Second	122	122	122
Theoretical Discharge in cu. ft. per second.	0.0935	0.0935	0.0935
Theoretical Discharge in lbs. per Second	5.83	5.83	5.83
Theoretical Horse Power	2 448	2.448	2.448
Co-efficient of Discharge	0.97	0.97	0.97
Actual Discharge in lbs. per Second	5.655	5.655	5.655
Efficiency, per cent.	55	55	80
Actual Horse Power.	1.306	1.306	1.900
Relative Horse Power	0.687	0.687	1.000
Cubic Feet of Water per Minute	5.44	5.44	5.44
Cubic Feet of Water per HP. per Hour	249.96	249.96	171.84
Gallons Water per HP. per Hour	1874.7	1874.7	1288.8
Cost per HP. per Hour at 10c. per 1,000 galls.	$0.187	$0.187	$0.129
Relative Cost to Operate	1.454	1.454	1.000
Cost per Horse Power to Buy	96.10	65.40	31.58
Relative Cost to Buy	3.04	2.07	1.00

Note: The motors referred to in the first two columns are generally recognized as fairly representing the various other types on the market; in fact, they are claimed by the manufacturers to be superior; it is not too much, therefore, to assume that they make a fair basis of comparison.

The cut here given shows a special multiple nozzle wheel employed for developing large power from comparatively low heads, and by which increased speed can be secured for running dynamos and other high speed machinery. While the cut shows four streams these can be increased to six or more. As all the streams have a separate and distinct line of impingement they do not conflict and there is no appreciable loss of efficiency. This wheel is intended for heads ranging from 25 ft. upward.

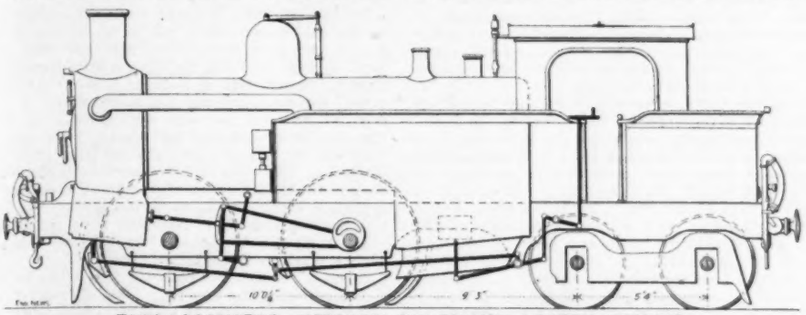
No. 2 Pelton wheels are also connected direct to the shaft of a Thomson-Houston dynamo with an insulating coupling. This plant, with a 12-in. wheel, will make 1,350 revolutions per minute under a water pressure of 140 lbs. and has a capacity of 65 incandescent lights of 16 c. p. each. In the Chollar shaft of the Comstock mines, where a head of 1,080 ft. is available, a 125 HP. Brush dynamo is successfully run with one of these wheels. The Roaring Fork electric light and power plant at Aspen, Colo., is run by 8 24-in. Pelton wheels under 820 ft. head, aggregating 1,400 HP. The enormous power of these wheels is shown by the fact that while the wheels weigh only 90 lbs. each they develop as a maximum 175 HP. each, or nearly 2 HP. per pound of metal in the wheel. If all accessories are included, such as shafting, pulleys, boxes, nozzles, gate, etc., the proportion would be 4½ lbs. of material for each horse-power; the relative proportion in the best type of steam plants is from 400 to 500 lbs. of material for every horse power developed. In a South American mine a pair of Ingersoll-Sergeant air compressors are run by two 4-ft. Pelton wheels attached direct to the compressor shaft. The Rand Drill Co. has also applied the same power to their duplex air compressor in La Union Mine, in Costa Rica. These are but a few cases from the long list of plants in use selected for the purpose of showing the range of application of this truly remarkable water wheel.

TANK LOCOMOTIVE FOR THE METROPOLITAN RAILWAY; LONDON, ENGLAND.

Since the opening, in 1863, of the Metropolitan Railway, which is one of the underground railways of London, only one type of engine has been used. The engines were specially designed for this road, and are eight-wheel tank engines with outside inclined cylinders, 17 × 24 ins., driving wheels, 5 ft. 9 ins. diameter, a four-wheel leading truck and side tanks, as illustrated and described in Engineering News, May 2, 1891. Some tank engines of a new type have recently been built by Neilson & Co., of Glasgow, for Mr. J. J. Hanbury, Locomotive Superintendent of the Metropolitan Railway, and are similar to a type of engine for suburban traffic used by several other roads (Eng. News, March 28, 1891). They closely resemble engines designed by Mr. James Stirling for the Southeastern Ry. (Eng. News, May 23, 1891.)

These engines have inside cylinders 18 by 26 ins., inclined 1 in 9; four coupled leading driving wheels, 5 ft. 6 ins. diameter, and a four-wheel trailing truck with wheels 3 ft. 9 ins. diameter. There are two side tanks and a rear tank and bunker behind the cab, and the boiler is supplied by two feed pumps and a Gresham & Craven injector. The driving springs are underhung, and are not equalized. The throttle valve is of the gridiron pattern. On the

top of the dome are two safety valves 3⅞ ins. diameter, adjusted to blow off at 140 lbs. pressure, and there is also a lock-up safety valve 2 ins. diameter, adjusted to blow off at 143 lbs. per sq. in. Like all the engines on the underground lines, these engines are fitted with an arrangement of pipes and valves by which when running through the tunnels the exhaust steam is turned into the tanks and condensed. Escape pipes are provided to let off the steam when the water in the tanks becomes hot; one of these pipes is shown behind the casing of the lock-up safety valve in the accompanying cut. A short pipe smokestack is used, and the height from



TANK LOCOMOTIVE; METROPOLITAN RAILWAY, LONDON, ENGLAND.

rail level to top of stack is 12 ft. 3 ins. The width over the foot plate is 7 ft. 11 ins., and extreme width, over steps, 8 ft. 5 ins. There is a brake shoe in front of each driving wheel, operated by hand or power. The Smith vacuum brake is used, and can be operated as a simple or automatic brake. The vacuum brake power is 1.08 tons per pound of pressure in the cylinder. The truck is of the rigid center type, and has plate frames, with laminated springs over the axle boxes. The driving axles have journals 7 ins. diameter and 7½ ins. long; while the truck axles have journals 5½ ins. diameter and 9 ins. long. All the journal bearings are inside the wheels. The cylinders are 2 ft. 4½ ins., c. to c., and the main frame plates come close against them, the distance between the frames being 4 ft. 1 in. The main frame plates are 1½ ins. thick. The total length of the engine is 29 ft. 5 ins. over the frames, and 32 ft. 8 ins. over the spring buffers. The following are the leading dimensions:

Cylinders (inclined 1:9)	18 by 26 ins.
Diameter of driving wheels	5 ft. 6 "
" of truck wheels	3 " 9 "
" of boiler, inside	4 " 3 "
Size of firebox	4 ft. 9½ ins. by 3 " 4 "
Tubes, number	185
" length	10 ft. 7½ ins.
" diameter outside	1¾ "
" pitch	2⅝ "
Boiler pressure	140 lbs.
Grate area	15 sq. ft.
Heating surface; tubes	832.5 "
" firebox	89.0 "
" total	921.5 "
Driving wheel-base	7 ft. 5 ins.
Truck "	5 " 4 "
Total "	22 " 0 "
Capacity of tanks, 1,000 imp. gallons.	1,200 U. S. gallons.
" of bunker	60 cu. ft.

THE PROPOSED ELECTRIC RAILWAY BETWEEN CHICAGO AND ST. LOUIS.

We have as yet no estimates of cost or prospective revenue, but we give the following description of this road as one of the latest attempts to solve the problem of rapid transit between great cities.

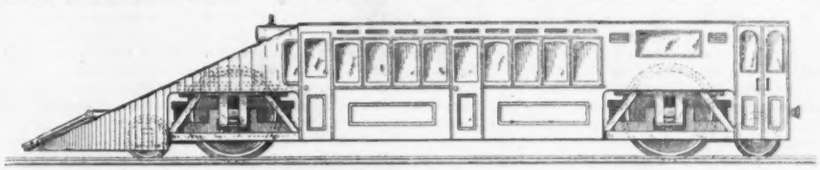
The inventor and chief promoter is Dr. Wellington Adams, who obtained "pioneer" patents for his system in 1883; and later patents have been issued to secure his various improvements. The locating of the line is peculiar in following a perfectly straight line between the cities of Chicago and St. Louis, the electric motors being depended upon to overcome all gradients up to 13⅓%. The length of the line is about 250 miles. At the extremely high high speeds proposed, the grades become comparatively unimportant with any motor.

The power proposed is electricity derived from a midway station located at a coal mine controlled by the company, and the estimated speed is 100 miles per hour. The road would be double track, to be ultimately enlarged to four tracks; the two outer tracks for local traffic and high class freight, and the two inner lines exclusively for passenger traffic, mail and high-class express matter.

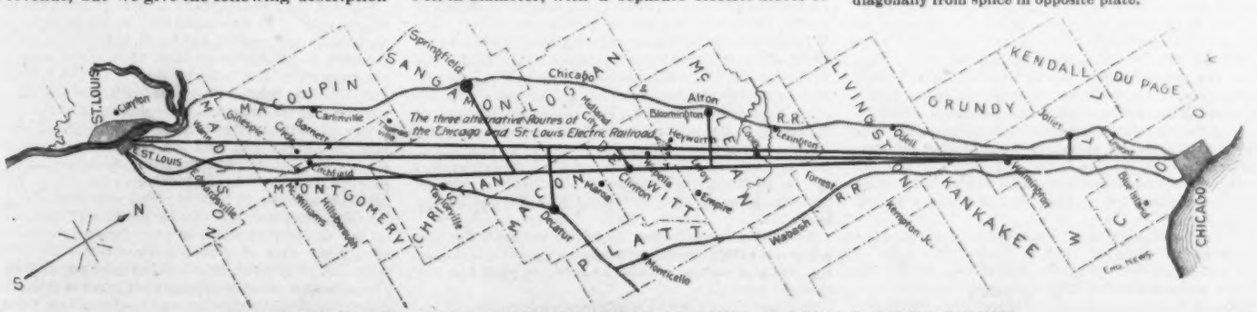
Safety is to be provided for by dividing the line into 25 sections of 10 miles each, with but one train on a block at a time, going at any speed. A complete block signaling system is said to be arranged for by means of incandescent electric lights, with telephonic communication between cars upon the same section, whether moving or standing still. Incandescent lights would also illuminate the track for a mile ahead and one mile behind all trains; and while it is intended to avoid grade crossings as much as possible, an electric bell will ring and a red electric light be shown at each crossing two minutes before the passing of the trains. It would be unnecessary to travel at night, so no through passenger trains would be run after 9 p. m., and the tracks could then be utilized for high-class freight, express and mail.

The electric car proposed is low, light and compact. The top of the car would be but 9 ft. above the rail, with a wedge-shaped nose in front, to decrease air resistance and assist in keeping the car down on the track. The driving wheels would be 6 ft. in diameter, with a separate electric motor to each pair, capable of giving "500 revolutions per minute" to the drivers. The entire car, with its motors, is to weigh 10 tons.

We have seen no profile of the road, but that part of Illinois is generally flat. The company thinks the road could be built "in 18 months for several million dollars,"—a somewhat vague estimate of cost. The problem is an interesting one, however, and, according to the prospectus of the company, the scheme is backed by influential men in St. Louis, including the governor of the state, and three of the professors of Washington University.



PROPOSED PASSENGER CAR FOR THE CHICAGO AND ST. LOUIS ELECTRIC RAILWAY.



MAP SHOWING ALTERNATIVE ROUTES OF THE CHICAGO AND ST. LOUIS ELECTRIC RAILWAY.

SPECIFICATIONS FOR FRAMING OF RAILWAY POSTAL CARS.

The Kipton collision of April 18, 1891, in which the fast mail between New York and Chicago over the Lake Shore & Michigan Southern R. R. was wrecked and six clerks of the Railway Mail Service were killed, called the attention of the Post Office Department to the need of greater strength in postal cars against collapse or telescoping in wrecks. A committee of three Superintendents of the service was directed to formulate specifications for the framing of postal cars; and after consultation with the Master Car Builders of several of the trunk lines, a set of specifications was recommended for adoption by the Post Office Department. We reprint them substantially in full as follows

Body.—Inside length in the clear, 60 ft.; inside width in the clear, 9 ft. 1 in.; height from floor to top of plate, 6 ft. 9⅛ in.; height from floor to ceiling at center, 9 ft. 4⅞ in.

Sills.—Side sills each composed of two pieces, 4 × 8 ins., well bolted together. A plate of iron, ⅛ × 8 ins., extends 18 ins. back from each end of car between the sills, the inner sill being gained ⅛-in. to receive plate, which is bent around and forms an angle against end sill. Center sills, 5 × 8 ins., also plated with ⅛ × 8-in. iron, extending back and bent round to form an angle against end sill. Intermediate sills, two on each side of car, 4 × 8 ins., between center and side sills. The foregoing ten longitudinal sills must be long-leaf Southern yellow pine, thoroughly seasoned. End sills, white oak, thoroughly seasoned, 8 × 8 ins., plated with ⅛ × 8-in. iron on bottom.

End plates.—To be 2¾ ins. thick, with iron plates ⅝ × 6 ins., on inner side at bottom, and plate turned into angle at end against side plates.

Bridging.—1¾ ins. wide every 18 ins. between all sills.

Body bolsters.—Double top and bottom plates 6 × 1 in.

Flooring.—Two courses; lower, crosswise or diagonal; upper, longitudinal, and made of rift sawed Southern yellow pine. There shall be three separate courses of ⅞ in. matched strips, well fitted in between all sills and placed lengthwise and crosswise alternately.

Studding.—2¼ × 2¾ ins., placed about 16 ins. c. to c. First and third posts from end of car plated on both sides with ¼ × 2¾-in. iron. All corner and end posts are plated with ¾-in. iron full height and width, with ends turned into angle against end plate and end sill.

Braces.—1½ × 6 ins., gained, glued and screwed to posts.

Belt Rail.—Not less than 1¾ × 4 ins., securely fastened by screws.

Side Plate.—Long leaf Southern pine, thoroughly seasoned, 2¾ × 5⅛ ins., with one splice in each piece, located diagonally from splice in opposite plate.

Rafters and Carlines.—1⅝-ins. thick, placed about 17 ins. c. to c. Nine iron carlines ⅝ × 2 ins., following the contour of upper and lower deck.

Truss Rods.—Two truss rods, 1⅛-ins. in diameter, with 1¾-in. ends and connected in center with turnbuckle.

Needle Beams.—Four needle beams, of oak, each 5 × 7 ins., trussed with two ⅝-in. truss rods applied in the usual manner.

Roof.—Covered with best quality tin, excepting hoods, which are to be covered with galvanized iron.

Platforms.—Whether Miller or Janney, are to be put up in accordance with the established standards, and in addition thereto the platform timbers are to be plated both sides with ¼-in. iron the full depth of the timbers, and draft timbers are to be plated in the same manner with ⅝ in. iron.

Trucks.—Axles should not be smaller than the 1891 M. C. B. standard for 30-ton cars, with bearings and oil boxes in proportion. There should be safety straps under the spring plank and brake beams. Wheel pieces should be plated on both sides with ⅝-in. iron. There should be six wheels (steel-tired preferred) to each truck, with wheels spread not less than 10 ft. Side bearings should be of a section not less than 2 × 3 ins. Equalizing bars, 2 × 4½ ins., made of the best hammered scrap.

Brakes.—Air and automatic, latest improved form of application.

All lumber must be thoroughly seasoned and of the very best quality for the purpose intended. Framing timbers of clear white oak, yellow poplar, and long leaf Southern yellow pine.

For cars of shorter length no change is to be made in the end construction nor in section or number of sills nor plating. The intermediate framing for shorter cars to be fully proportionate to that for 60-ft. cars. Where four-wheel trucks are used on short cars, the bolsters may be single instead of double, and where single, to have top and bottom plates 8 × 1 in.

NOTES ON THE SELECTION OF IRON-ORES, LIMESTONES AND FUELS FOR THE BLAST-FURNACE.*

Apart from the character of pig iron to be manufactured, other than that it shall be well reduced and open-grained, the selection of the materials should be such as to produce it at the lowest cost. As a rule, the sources of fuels and limestones are not so extensively varied as those of the ores. Many Eastern furnaces are now using Lake Superior ores, and but recently a part of the supply came from foreign ports. It is, however, of the highest importance that the character of fuels and limestones, as well as ores, should be carefully considered in determining their value and making judicious selection among those available.

The formulas here offered are based upon the assumption that the heat-requirements for a given mixture are measured by a constant required by the oxide of iron, added to that required for a unit of slag, multiplied by the weight of that slag per unit of iron. The heat-requirements for oxide of iron per unit of pig-iron made are assumed to be 5,137 h. u. (lbs. Fahr.). This is taken from the careful analysis of Sir Lowthian Bell, and, so far as the writer is able to determine, is very nearly correct. Dividing this by the quantity of heat that may be evolved and utilized within the furnace per unit of carbon determines the quantity of carbon required per unit of pig-iron; and if to this be added the quantity of carbon absorbed by the pig iron, the total requirements in carbon are determined, on the assumption that pure oxide of iron is reduced with pure carbon by the ordinary process of the blast-furnace. Calculating the quantity of slag that would be made from a given mixture of ores, smelted with a given impure fuel and fluxed with a given impure limestone, multiplying this weight of slag by the heat-requirements of its unit (taken at 1,890 h. u.), and dividing the product by the heat-units evolved and utilized within the furnace per unit of carbon, will determine the quantity of carbon required per unit of pig iron for the slag. This added to the former quotient gives the total requirements in carbon, and this divided by the per cent. of carbon in the fuel used gives the weight of fuel required per unit of pig iron. It is assumed that the same quantity of heat will be absorbed in the disassociation of all oxides of iron; that the slag will be kept as nearly constant in composition as practicable, at least having the sum of the silica and alumina equal to the sum of the lime and magnesia; and that the furnace manager, in selecting his materials, will guard against excessive sulphur. It is the belief of the writer that the great difficulty that has been experienced in treating some ores is due to other unfavorable conditions rather than to the fact that any one ore would require a considerable quantity of heat more than another, aside from the heat required by a larger weight of slag produced.

The rules and examples here given are calculated for blast furnaces where the blast is heated from 1,200 to 1,500° F., and for such quantities of sulphur as are usually found in our coke and anthracite practice.

Should it be wished to apply the rules to cases of lower blast-temperature, the divisor 8,280 here employed must be reduced. It is not practicable to give divisors for all temperatures of blast; but the writer is fully convinced that where the conditions are correct, the loss in the quantity of heat utilized within the furnace per unit of carbon, when using the blast at lower temperatures, will only be that abstracted from the blast. But it will be found that only when the slag has a low fusion-point and the furnace is high can the very best results be obtained in using blast at atmospheric temperatures. A demonstration of this proposition is found in the results of a cold blast charcoal furnace, 60 ft. in height, in which good gray car-wheel iron was manufactured with blast at atmospheric temperatures, with 2,300 lbs. of weighed charcoal to the ton of pig-iron. When any ores were used slightly increasing the fusibility of the slag, the grade of iron dropped at once.

The quantity of work done by the carbon charged in that case was found by calculation to be equal to the very best record of furnaces using superheated blast; the difference in fuel consumption being only that quantity of carbon which would furnish in one case the extra heat carried in the other cases by the blast.

The figure 8,280 h. u. given in these rules as the heat utilized within the furnace from a unit of carbon burned is taken from careful calculations, and is believed to be what can be actually expected under good management. The very best result that has come under the writer's observation was better than 8,820 h. u., or about equal to 62% of the total heat to be derived from the combustion of carbon. And we may incidentally remark that, as the remainder of the heat is more or less completely utilized in driving the blowing-engines, hoisting the material, pumping water, etc., the best furnace-practice certainly leaves very little to be desired in the way of fuel-economy. Our friends who still believe in the superior efficiency of a direct process should remember what a small margin they have for possible economic improvement. A more promising field is presented, for instance, by the steam-engine, from which we rarely get more than one-tenth of the dynamic energy of the fuel, while in the blast-furnace, we certainly obtain, under the best conditions, fully 75%.

Since ores are often gathered in the stock-houses of our Eastern furnaces from a range of territory extending from our Great Lakes to the northern coast of Africa, it is important to have some criterion for careful selection. With pure and cheap fuel there is not the same necessity for the selection of high grade ores. As the fuel deteriorates in quality or increases in cost, and more especially when both of these disadvantageous conditions arise, the purity of the ore will more largely affect the cost of pig iron. In the same way, but to less extent, the purity of the limestone to be used as flux affects the value of the ore. It is necessary, therefore, in making a calculation looking to the selection of ores that the character of the fuel and limestone, and their cost laid down in the stock house should be first determined. If, on the other hand, a given ore and limestone are to be used, and their composition and cost has been accurately determined, the selection of the fuel becomes a matter of easy calculation.

It is probably better for such purposes to consider as the cost of an ore the total cost chargeable to that ore per unit of pig iron when it reaches the condition of pig iron, including the cost of limestone (namely, its purchase, its hauling and the cost of the fuel required by reason of the presence of its gases and earthy impurities), the cost of the fuel (namely, its cost laid down in the stock house, together with the cost of handling it and that of the limestone required to flux its impurities, the fuel required to melt them, or to melt the slag they form).

Each rule is followed by an example. The problems treated begin with the efficiency of the limestone, and proceed to the weight of the limestone required either for an ore or a fuel, the weight of the slag due to the impurities of the ore, the limestone and the fuel, the carbon required per unit of slag, the carbon per unit of pig-iron, the available carbon of the fuel, the fuel required per unit of pig-iron, and the manufacturing cost, which is divided (or attempted to be divided) so that each of the different materials, according to its degree of purity, would bear its proper proportion of the cost. Without considering the manufacturing cost, the relative value of materials could not be closely determined. The examples end with a calculation of the cost of the pig iron based upon the purchase-price of the materials, with the actual cost of manufacturing and the calculated cost of materials, as if smelting pure oxide of iron with pure carbon the results tally. The value of the extra quantity of fuel (over the carbon) required, smelting the extra quantity of impure ore, and the cost of the limestone with all the extra labor entailed is merged into the cost of the materials.

By making a calculation, as herein outlined, for any materials within reach, the furnace manager will at once see what selections should be made to yield him the cheapest product.

This paper does not necessarily involve discussion of the composition of slags, since any given composition of slag may be introduced into the calculation. The writer would merely say, therefore, that so far as he can judge from experience and observation, the composition upon which the following rules are based is (all around) the best he has met with in smelting iron ores with the usual mineral ores of the country, where the proportion of sulphur is not excessive. Should the proportions of magnesia or alumina, however, be abnormal, or worse still, should both of these ingredients be present in high proportion, the quantity of fuel indicated by these calculations will be found insufficient for good open-grained iron.

As to sulphur, it is believed that when the usual amount of 1% (or rather less) in the fuel is not exceeded, this composition of slag will be eminently satisfactory. A somewhat more acid composition, perhaps, might be economical where the amount of slag is large. Phosphorus is not here considered, as the present calculation has reference only to the quantity of fuel required, the wear and tear and the labor, as affecting cost of production, which phosphorus, as a rule, does not affect.

Touching the manufacturing cost, it is assumed that the material is delivered on cars in the stock house; and at that point these calculations commence. The stock house expense, including charging, is distributed in proportion to the weight of material handled; the stock-house expense attending the manufacture of pig from an oxide of iron with carbon, being the handling of 1⅞ tons of oxide plus 0.66 tons of carbon, total 2.09 tons; and the balance of such expense being chargeable to the slag. The other furnace-labor directly affected by the product, apart from technical economy, comprises the expense of keepers, breakers, carriers, graders and loaders, all of which is directly chargeable to the pig; the pay of guttermen and all other cost in moving and disposing of the slag being chargeable to the slag.

The blast necessary to burn 0.66 tons of carbon will make a ton of pig iron from pure oxide of iron, and any additional blast that may be requred is chargeable to the slag. The combustion of this 0.66 tons carbon in producing a ton of pig iron will generate the 5,137 h. u. required, and the additional blast, consuming the additional fuel, must generate the 1,890 h. u. per unit of slag made, the blast requirements being proportional to the heat requirements. Multiplying these 1,890 h. u. for the slag by its weight per ton of pig, and adding this product to 5,137, the proportion which this sum will bear to either of the items composing it, will give a ratio for dividing the manufacturing cost into the proper amounts chargeable to the pig and to the slag respectively. In the example given below the total expense is $3 per ton. As there is 0.75 ton of slag made per ton of pig, 0.75 × 1,890 should be added to 5,137, giving a total of 6,554.5; and this, divided into 5,137 times $3, gives $2.35 for the pig, leaving 65 cts. for the slag.

The relative proportions of labor and expense, however, having been found in practice rather higher than this ratio, the rule was adopted which gives upon this quantity of slag $2.24 for the pig and 76 cts. for the slag. Individual managers can go through this more exhaustively, each taking his own particular furnace and correcting the rule to suit his conditions. I would say, however, that for safety in estimating profits, it would be well to rate the cost somewhat above the actual figures shown by the books.

The fuel consumption and the quantity of blast being measured by the heat requirements, these requirements are a measure of furnace capacity; for a modern blast furnace is limited in product by its capacity to furnish and heat the blast. Consequently the heat requirements affect in due proportion all fixed expense. It is reasonable to assume that the wear and tear of the furnace lining is proportioned to the quantity of heat generated in it, and on this assumption the cost is chargeable as above. I am not inclined to believe that abrasion is the chief active agent in the destruction of linings.

On the supposition that the fixed expenses, the wear and tear and renewals throughout, the supervision of the engines and boilers, etc., are all chargeable in proportion to the heat requirements of the slag and the pig, and to the labor about the furnace, divided in proportion to the amount of material to be handled, the rules here given will be nearly correct for the distribution of the entire manufacturing cost.

Some of the rules might have been omitted, but it was thought that if all were given they would be more readily understood and applied, and could, at the same time, be modified to suit conditions other than those assumed in the examples. It is believed that the rules will not be difficult of application if the composition of the different materials be set down in tabulated form, and the results of one calculation after another be entered. The rules bear upon each other, and the calculations involved include some of those which are always necessary in furnace practice, and hence do not involve extra work. All the results can be put in compact and comprehensive form for ready reference, and will be good for all time, except so far as improvements in blast furnace practice may modify the data of manufacturing cost and fuel consumption. Moreover, after making these calculations for a considerable number of materials, one can judge very closely, by simple inspection and analogy, the value of other materials presented for consideration.

At all events, the writer has found these rules extremely convenient in facilitating the choice of materials, having been practically unable, in many instances, before he had compiled them, to decide positively among different ores, etc., offered. In the belief that formulas of

*A paper by Fred. W. Gordon, Philadelphia, Pa., read at the Baltimore meeting of the American Institute of Mining Engineers.

this nature, based on average conditions and reasonable assumptions, however open to theoretical criticism in minute details, will be useful to iron masters in their daily work, these results of study and practice are submitted.

Rules.

I. To Determine the Efficiency of Limestone.—From the sum of the lime and magnesia deduct the sum of the silica and alumina.

Example—The limestone containing:
CaO .50, MgO .025, SiO_2 .03, Al_2O_3 .01.
Then (.50 + .025) − (.03 + .01) = .485.

II. To Determine the Weight of Limestone Required to Flux the Unit of a Given Ore.—From the sum of the silica and alumina in the ore deduct the sum of lime and magnesia and divide the remainder by the figure representing the efficiency of the limestone.

Example.—The limestone being as in the preceding example and the ore containing:
Fe .55, SiO_2 .103, Al_2O_3 .026, CaO .028, MgO .019.
Then $\frac{(.103 + .026) - (.028 + .019)}{.485} = \frac{.082}{.485} = .17.$

III. To Determine the Weight of Pure Lime Required to Flux the Unit of a Given Ore.—From the sum of the silica and alumina in the ore deduct the sum of the lime and magnesia.

Example.—The ore being as above: .103 + .026 − (.028 + .019) = .082.

IV. To Determine the Weight of Limestone Required for the Unit of a Given Fuel.—From the sum of the silica and alumina of the ash of the fuel, deduct the sum of the lime and magnesia; divide the remainder by the efficiency of the limestone, and multiply the quotient by the ash of the fuel.

Example.—The fuel containing carbon, .85, and ash, 11; and the constituents of the ash being:
SiO_2 .53, Al_2O_3 .28, CaO.02, MgO.01.
Limestone, as before.
Then (.53 + .28) − (.02 + .01) = .78; .78 ÷ .485 = 1.608; 1.608 × .11 = .177.

V. To Determine the Weight of Pure Lime Required to Flux a Given Fuel.—From the sum of the silica and alumina of the ash deduct the sum of the lime and magnesia, and multiply by the percentage of ash.

Example.—Fuel as before.
Then (.53 + .28 − [.02 + .01]) × .11 = .0858.

VI. To Determine the Weight of Slag Due to the Impurities of a Unit of Limestone.—From the sum of the lime magnesia, silica, and alumina of the limestone deduct its efficiency, and add 5% to the remainder.

Example.—Limestone as before.
Then (.50 + .025 + .03 + .01) − .485 = .08 + 5% = .0804.

VII. To Determine the Weight of Slag Due to the Impurities of a Limestone per Unit of Its Efficiency.—Divide the slag found under Rule VI. by the Efficiency.

Example.—.0804 ÷ .485 = .1658.

VIII. To Determine the Weight of Slag Due to the Impurities of a Fuel per Unit of Fuel.—Multiply the sum of the silica, alumina, lime and magnesia of the ash of the fuel by the percentage of ash. Add to this the sum of the silica, alumina, lime and magnesia per unit of limestone, multiplied by the weight of limestone required for this fuel, and to the sum add 5%.

Example.—Fuel and limestone as before.
Then (.53 + .28 + .02 + .01) × .11 + (.50 + .925 + .03 + .01) × .177 = .1924 + 5% = .202.

IX. To Determine the Weight of the Slag Due to the Impurities of a Fuel when Fluxed with Pure Lime.—Multiply the sum of the silica and alumina of the ash by 2, add 5%, and multiply by the percentage of ash in the fuel.

Example.—Fuel and slag as above.
Then (.53 + .28) × 2 × .11 + 5% = .1871.

X. To Determine the Weight of the Slag Due to the Impurities of an Ore and Limestone per Unit of Ore.—To the silica, alumina, lime and magnesia of the ore, add the sum of the same constituents per unit limestone, multiplied by the weight of limestone required, and add 5%.

Example.—Material as above.
Then (.103 + .026 + .028 + .019) + (.50 + .025 + .03 + .01) × .17 = .271 and .271 + 5% = .285.

XI. To Determine the Weight of the Slag Due to the Impurities of an Ore per Unit of Its Peroxide of Iron.—Divide the weight of slag, found by Rule X., by ⅔ of the iron in the ore.

Example.—Material as above.
Then, .285 ÷ (.55 × ⅔) = .363.

XII. To Determine the Weight of the Slag Due to the impurities of an Ore When Fluxed with Pure Lime.—Multiply the sum of the silica and alumina by 2, and add 5%.

Example.—Material as above.
Then (.103 + .026) × 2 + 5% = .271.

XIII. To Determine the Weight of the Slag Due to the Impurities of an Ore per Unit of Its Iron.—Divide the slag found by Rule X by the iron in the ore.

Example.—.285 ÷ .55 = .518.

XIV. To Determine the Carbon Required per Unit of Slag.—Divide the furnace requirements of heat per unit of slag by that which may be expected from a unit of carbon in the furnace.

Example.—$\frac{1290 \text{ b. u. required per unit of slag.}}{8280 \text{ b. u. expected per unit of carbon.}}$

Then, 1290 ÷ 8280 = .228.

XV. To Determine the Carbon Required per Unit of Pig Iron.—Divide the furnace requirements of heat per unit of pig iron made from pure oxide of iron, with pure carbon as fuel, by that which may be expected from a unit of carbon in the furnace and add .04.

Example.—5437 b. u. being required per unit of pig, $\frac{5437}{8280}$ = .6204 + .04 = .6604.

XVI. To Determine the Available Carbon of a Fuel.—Multiply the slag due to the impurities (Rule VIII.) by .228 (Rule XIV.), and deduct the product from its per cent. of fixed carbon.

Example.—.202 × .228 = .046; .85 − .046 = .804.

XVII. To Determine the Fuel Required for a Unit of Slag.—Divide .228 by the available carbon of the fuel.

Example.—.228 ÷ .804 = .285.

XVIII. To Determine the Fuel Required per Unit of Pig Iron.—Divide .06 by the efficiency of the fuel (Rule XVI.).

Example.—.06 ÷ .804 = .821.

XIX. To Determine the Fuel Required per Unit of Pig Iron from a Given Iron Ore, Limestone and Fuel.—Add together the slag due to required weights of ore and limestone, and multiply the sum by .228, to the product add .0604, and divide the sum by the efficiency of the fuel.

Example.—Materials as above.
Ore required at 55% = 1.818.
Slag (example given above) 1.818 × .285 = .518.
Limestone .17 × 1.818 = .309; .309 × .0804 = .0248.
(518 + .248) × .228 = .1238.
(.1238 + .0604) ÷ .804 = .975 = the fuel required.

XX. The Manufacturing Cost of Pig Iron Made Having Been A Dollars, and the Weight of the Slag to the Unit of Pig Iron Having Been B; to Determine the Manufacturing Cost per Unit of Slag and Unit of Iron.—Multiply B by .45 and add 1; divide this sum into cost A, and the quotient will be the cost per ton of p g. Deduct this cost of pig from the total A, and the remainder will be the cost of the slag. Divide this cost by the weight of the slag and the quotient will be the cost per unit of the slag.

Example.—Manufacturing cost from last year's operations, $3.00 per ton of pig iron; weight of slag .750 to 1 of pig iron.

Then, .750 × .45 + 1 = 1.337; $\frac{3}{1.337}$ = $2.24 = cost of pig had it been made from pure oxide with carbon.
$3.00 − 2.24 = 76 cents, cost of slag per ton of pig.
$76 ÷ 75 = $1.01, cost per ton of slag.

XXI. To Determine the Weight of Slag to the Unit of Pig-Iron.—Add the weight of slag from limestone, multiplied by the required quantity for both ore and fuel, to the weight of slag from the ore, multiplied by the weight of ore used, and add to the sum the weight of slag from the fuel, multiplied by the weight of the fuel used.

Example.—Materials as above.
Then, .0804 × (.177 × .971 + .17 × 1.818) = .0386; 1.818 × .281 = .516; .971 × .202 = .196; .0386 + .516 + .196 = .750.

XXII. To Determine the Value of Pure Carbon from the Cost of the Fuel and the Cost Incurred by Its Impurities:

Divide the price of the fuel by its available carbon, $4.00 ÷ 804 = $4.975.

Add the cost of the limestone required (IV.) .177 × (XVI.) .804 × $1.25 = .275.

Add the manufacturing cost of the slag for the fuel and limestone per unit of available carbon (VIII.) .202 × (XX.) .101 ÷ (XVI.) .804 = .254.

Total, $5.504.

XXIII. To Determine the Value of Pure Lime from the Cost of the Limestone and the cost Incurred by its Impurities:

Divide the cost of the limestone by its efficiency, $1.25 ÷ (I.) .485 = $2.577.
Add the cost of the carbon required by its impurities (VI.) (.0804 × (XIV.) .228) ÷ (I.) (.485 × (XXII.) 5.504) = .208.
Add the manufacturing cost per unit of efficiency (VI.) .0804 × (XX.) $1.01 ÷ .485 = .165.
Total, $2.950.

XXIV. To Determine the Value of Pure Oxide of Iron from the Cost of an Ore and the Cost Incurred by its Impurities:

Divide the price of the ore by the percentage of its oxide of iron ($3 ÷ .55) + ⅔ = $3.818.
Add the value of the carbon (XXII.) required by the impurities of the ore per unit of oxide (XII) .271 ÷ .785 × (XIV.) .228 × (XXII.) $5.504 = .433.
Add cost of lime required per unit of the oxide (V.) .0858 ÷ .785 × (XXIII.) $2.95 = .315.
Add manufacturing cost for the slag per unit of the oxide (XII.) .271 ÷ .785 × (XX.) $1.01 = .348. Total, $4.914.

XXV. Cost of the Pig, Assuming the Calculated Values for the Pure Materials:

⅔ tons of oxide of iron, at (XXIV.) $4.914 = $7.02.
(XV.) .0604 ton of carbon, at (XXII.) $5.504 = $3.66.
Manufacturing cost (XX.) = $2.24.
Total, $12.92.

XXVI. Cost Calculated in the Usual Way:
(XIX.) 1.818 tons of ore, at $3 = $5.454.
.975 ton of fuel, at $4 = $3.900.
(II. and IV.) .48 ton limestone, at $1.25 = $.600.
Manufacturing cost = $3.000.
Total, $12.954.
Difference, $.034.

HYDRAULIC MINING IN CALIFORNIA.

The prospects for the resumption of hydraulic mining in California seem to be very bright. Some ten years ago the fight between the miners and the inhabitants of the river valleys culminated in a permanent injunction, sustained by the courts of last resort, by which hydraulic miners were forbidden to turn their debris into the rivers. The practical effect of this injunction was to put a stop to hydraulic mining except in a very few localities. The farmers, whose lands had been injured by the "slickens" from the mines, and the inhabitants of the cities in the river valleys, whose homes had been threatened by floods caused by the choking up of the channels of the streams, thus secured the end they desired. They had not counted, however, on the injury they would themselves suffer in the loss of a profitable market and the stagnation in industry consequent upon the stoppage of the mines. There has been, therefore, a general growth of sentiment in favor of permitting the hydraulic miners to resume work. Not long ago, a commission of engineers appointed by the United States Government made a report to the effect that hydraulic mining could be resumed without injury to the river valleys and navigable streams if dams for retaining the debris were erected at various points, at an estimated total cost of $1,700,000. The total amount of gold in the placers which would thus be opened for working is estimated at $365,000,000.

A convention of the miners of California was held at San Francisco Jan. 20 and 21. Representatives of the farmers were present and the best of good feeling was prevalent. Resolutions were adopted affirming the intention of the miners to obey the laws and refrain from hydraulicking until it could be carried on without injury to the farmers. A memorial to Congress was drawn up asking for the immediate appropriation of funds for the construction of the proposed dams and river improvements, according to the recommendations of the Commission, and a committee was appointed to go to Washington and co-operate with the California senators and representatives in securing the desired legislation.

SHAFT SINKING BY FREEZING, IN FRANCE.

Shaft sinking, by the freezing method of Mr. Poetsch, is now being carried on at the coal mines of the Lens Mining Co., in North France, near Valenciennes. The coal deposits are here overlaid by about 113 ft. of chalk, with water-bearing seams, changing into blue marly clay at 138 ft. below the surface. The latter point was taken as the lower limit of freezing, and 28 bore holes were put down by hand.

The completed pit was to be 16 ft. in diameter and eight holes were bored within this area, and the remaining 20 arranged irregularly about it, so as to cover a space about 25 ft. square. Each hole was lined with a 6-in. pipe, and inside this was placed a central 2-in. circulating pipe, fitted with bottom plug and top cap and nozzles, after the manner fully described in "Engineering News" of July 5, 1884, and so well known that little more need be here said of the method itself.

Several months were required to freeze the ground to the full depth of the holes, but this was accomplished by Jan. 19, 1892, and excavating was commenced. In the upper fissured chalk the water-bearing seams were entirely filled with ice, and the more compact ground below resembled a hard Portland stone, with a toughness under the pick resembling gypsum and requiring small powder charges in the sinking.

At the time of the visit of the Federated Institute of Mining Engineers, reported in "The Engineer," the sinking was progressing at the rate of about 3 ft. per day, the shaft being made large enough to take a 16-in. concrete backing behind the iron lining. It was found that the concrete would not set while in contact with the frozen ground; but this difficulty was overcome by adding a small quantity of caustic soda to the water used in mixing. The shaft was lighted by a group of incandescent electric lights, suspended 12 ft. above the bottom. When finished the pit will be lined with cast iron to a depth of 271 ft. below the surface.

THE OTTO GASOLINE ENGINE.

Messrs. Schleicher, Schumm & Co., of Philadelphia, makers of the Otto gas engine, have recently placed on the market a new type of engine using liquid gasoline as the working fluid, differing thus from the common gasoline engines, which are really gas engines using a gas made by passing air through a gasoline carbureter.

The tank containing the fluid gasoline is designed to be placed outside the building, thus avoiding the storage or use of gasoline in the engine room. It may, indeed, be placed at a considerable distance if

desired; and when filling it no fire or light need be near. The small pipe from the tank to the engine may be made of galvanized iron, and soldered at the joints as an extra precaution.

The gasoline is drawn from the supply pipe into the cylinder of the engine, where it is instantly converted into spray and at the same time mixed with air. As no gas machine or carbureter is used with this engine, its running is not influenced by changes of temperature or by changes in the gravity of the gasoline between that evaporated when the carbureter is first filled and that which comes over when it is nearly empty. The frequent adjusting of the gasoline and air inlets is also dispensed with.

The engine is supplied with either a tube or an electrical igniter as desired. The tube is the most simple and efficient, but the electrical igniter dispenses with keeping a flame burning near the engine.

The consumption of the gasoline is regulated by the governor in proportion to the work done by the engine. The average consumption of gasoline in ten hours is stated to be not over one gallon for each rated horse power. At 8 cts. per gallon for gasoline, this makes the cost of fuel per horse power about less than one cent. The gasoline used is of heavier gravity and cheaper than that generally used for lighting purposes.

When desired the engine is made portable and mounted on trucks; and with this in view it has been designed to use the minimum quantity of cooling water. A 15 HP. engine will run all day with a barrel of water. The engines are built in a half dozen sizes, varying from 3 HP., actual, weighing 1,250 lbs., to 27 HP., actual, weighing 6,200 lbs.

THE CONSUMPTION OF WOODEN TIES ON FRENCH RAILWAYS.

The following is abstracted from the yearly reports of Mr. Henry Michel, Chief Engineer of the Southern Railway of France. Only the six great lines and the State Railways are considered in the tables, as only approximate figures about the smaller lines are available. Those latter, however, amount to only 10% of all French railways, and will not alter the results to any great extent.

The length of track of the six great systems and of the State Railways amounted in 1889 to 27,681 miles. The number of wooden ties used for its maintenance was 2,372,079; whence 85.5 ties were used for each mile of track. Assuming that 1,930 ties, approximately, are laid in each mile of track, then about 4.4% of those were renewed in 1889. The year 1883 is used as starting point, because only from this year upward reliable data are available.

Years.	Total No. ties required for maintenance of track.	Length of tracks. Miles.	Consumption of ties per mile.	P. c. renewals.
1883	3,601,019	21,062	171	8.9
1884	3,419,276	23,965	142¼	7.4
1885	2,815,077	25,135	111⅞	5.8
1886	2,279,153	26,004	87¾	4.5
1887	2,232,968	26,629	84	4.3
1888	2,330,538	27,167	86⅛	4.5
1889	2,372,079	27,681	85⅝	4.4

This table shows clearly that the consumption of ties has decreased from 1883 to 1887. In the latter year the number required per mile amounted to less than one-half that of the former. Since 1887 the amounts do not vary much. It is evident that from that year more care has been bestowed upon the selection of the timber, the ballasting of the track and the preservation of ties by creosoting and similar processes.

The timbers used for making up the amount of ties given in this table for 1889 were:

	Length miles.	—No. of ties used 1889.— Oak.	Beech.	Red Spruce.
Western Railway	3,891	129,496	147,480	.....
Northern "	3,112	54,362	331,347	.....
Eastern "	4,598	547,584	66,703	642
Orleans "	4,684	543,932	.....	1,161
Paris, Lyons & Med.	7,371	619,854	152,982	.....
Southern Railway	2,316	170,948	.....	322,475
State Railways	1,709	89,745	.....	64,555
Total (3,241,356 ties)	27,681	2,155,921	696,602	388,833

Of these ties, 869,000 were used for construction. The entire supply was grown in France. The home supply has been nearly constant at 3,000,000 per year since 1883, but at that time it was necessary to import 1,000,000 or more annually, which import has been gradually decreasing until it ceased in 1889.

It would appear from the preceding that the life of wooden ties in France has now become nearly constant at about 22 years. In this country it is just about one-third of that, owing to the fact that, with rare exceptions, we do not creosote or otherwise treat our ties.

CENTRAL LONDON RAILWAY.

Arrangements are being made for the construction of another underground electric railway in London, England, the authority for which was granted by Parliament in August, 1891. The route will be under the main east and west thoroughfare of the city, including Cheapside, Holborn, Oxford St. and Uxbridge Road. An underground railway along this route has been projected at frequent intervals during the last 20 years, as it would be assured of a very heavy traffic, and since the successful operation of the City & South London Ry. by electricity, a company has been granted authority to build this Central London line. The line will commence near the Royal Exchange, in the heart of the city, and extend to Shepherd's Bush, a distance of about 6 miles. A short eastern extension to the Liverpool St. terminus of the Great Eastern Ry. is also projected. There will be two single track tunnels, 11 ft. 6 ins. diameter, at an average depth of about 50 ft. below the surface, and the 12 or 13 stations will have both elevators and stairs. Borings are now being made, and it is expected that work can be completed within two years from its commencement. The company has a capital of $13,500,000 in stock and $4,500,000 in bonds, or an average of $3,000,000 per mile of double track line built and equipped. The engineers are Sir John Fowler, Sir Benjamin Baker and Mr. J. H. Greathead. Separate electric plants will be used for motive power and lighting. Plans are being prepared for the electric plant, and the stations and cars are to be lighted by electricity. Trains will be run at intervals of 2 or 3 minutes, according to the time of day and the amount of traffic. The average speed is to be at least 14 miles per hour, including stops, for the whole length of the line, but will be 18 miles per hour on the western half. The success of the City & South London Ry. and the passage of the bill for the Central London Ry. has naturally led to a number of other electric underground roads being projected this year. One of them is for a lengthy extension northward of the first named line, and others are to connect the important railway termini on the south side of the Thames with those on the north side.

PERSONALS.

Mr. White, City Engineer of Santa Fe, N. Mex., has resigned his position.

Mr. A. R. Barrett, Division Master Mechanic of the Boston & Maine R. R., has been appointed Superintendent of Motive Power, vice Mr. Wm. Smith, deceased.

Mr. M. H. Ledbetter, bridge builder and contractor, died at Los Angeles, Cal., Feb. 5. It is said that through his efforts a material advance was made in the character of structures in Southern California.

Mr. J. M. Willard, late Engineer of Maintenance of Way on the Western Division of the Northern Pacific R. R., has resigned his position to accept that of Chief Engineer of the Bowers Dredging Co., of Chicago, Ill.

Mr. W. S. Jones, Assistant Superintendent of the Middle and Eastern divisions of the Rome, Watertown & Ogdensburg R. R., has been appointed Superintendent of the Providence Division of the New York & New England R. R., vice Mr. L. W. Palmer, resigned.

Mr. Dimetry Mindeleff died in San Francisco, Cal., on Feb. 12. He was a Russian by birth, but emigrated to America when about 50 years old. He had a considerable reputation as a chemist and metallurgist, several of his more important inventions having been patented, among which were a new method for the reduction of cobalt and nickel ores, the destruction of phylloxera by means of pyroligneous acids and the invention of "terrorite," the new high explosive.

Dr. Thomas Sterry Hunt died of heart disease in New York, Feb. 12. He was born in Norwich, Conn., Sept. 5, 1826. In 1845 he became a special student of mineralogy and chemistry under Prof. Benjamin Silliman in Yale College, and afterward his assistant. In 1847 he was appointed chemist and mineralogist to the geological survey of Canada, and held that place until 1872. He made the first systematic attempt to divide and geologically classify the stratiform crystalline rocks, and pursued their study not only throughout Canada and the United States, but also upon the British islands and upon the European continent. He published, in 1887, a volume entitled "A New Basis for Chemistry," and in 1891, "Systematic Mineralogy." He wrote and published many other books and papers. He was one of the organizers of Laval University at Quebec, and he was professor of chemistry there from 1856 to 1862; he was a lecturer in McGill University, Montreal, and from 1872 to 1878 professor of geology at the Massachusetts Institute of Technology. He was a Fellow of the Royal Society, and had been president of the American Association for the Advancement of Science, the National Academy of Sciences, the American Institute of Mining Engineers, and the American Chemical Society, and a founder and president of the Royal Society of Canada. He was the first secretary of the International Geological Congress, and was a vice-president at their meetings in 1878, 1881 and 1888. He retired from public life in 1878.

NEW PUBLICATIONS.

THE CORPORATION PROBLEM. The Public Phases of Corporations, Their Uses, Abuses, Benefits, Dangers, Wealth and Power, with a Discussion of the Social, Industrial, Economic and Political Questions to Which they Have Given Rise. By Wm. W. Cook. 12mo. pp. 253.

Mr. Cook is the author of a well known work on Corporation Law, in the preparation of which, he says, he became familiar with many facts and principles relating to corporations which did not properly belong in the work on law. He has therefore discussed in a separate book the various corporation problems from the standpoint of the public but with the knowledge of a lawyer thoroughly versed in corporation law. Mr. Cook discusses at length the various controversies to which corporations have given rise, and the numerous remedies proposed and quotes extensively from other writers. Some of the views expressed regarding railways, and especially as to charging what the traffic will bear, which principle he seems heartily to disapprove of, are subject to criticism, but need not be discussed here as the main interest centers in the conclusions regarding the solution of the railway problem, which are as follows:

Consolidation is the only available solution of the railroad problem. State ownership is hostile to Anglo-Saxon instincts and settled ideas of government. State socialism, such as Germany is fast drifting into, is out of the question in America. Federal or State regulation of rates and abuses does not cure the evils or remove the danger that the railroads will dominate the state. Co-operation or profit-sharing is impracticable.

The author then states that with the continuation of the growing tendencies toward both federal regulation and railway consolidation the question will soon be: "Shall the State rule the railroads or the railroads the State?"

Whatever one's views of the ultimate solution of the railway question may be, the above conclusions of a close student of corporation laws and problems are of great interest, especially as the conclusions have been reached after a review of the opinions of a large number of writers on the subject, quoted at length in the book under consideration.

Natural monopolies are given a chapter. The author states that many valuable franchises, which should at least bring a large revenue to the public, have been given away. Taxation is said to be one method of redeeming for the people a small part of the value of such franchises. "Theoretically," says Mr. Cook, "the tax should take all the annual income, except such as will pay the reasonable expenses of the corporation and a fair return on the cost of the plant." In the case of such monopolies as street railways, water-works, gas-works, electric lights, telegraph and telephone lines, wharves and ferries, or such of these as are within city limits, city ownership is considered desirable. The city need not operate such works but may lease them for short periods. The objections mentioned to municipal ownership of such monopolies are that the people would thus be taught to look to and depend upon government for the transaction of business and that "unmitigated corruption and mismanagement" might arise.

Municipal ownership or control of natural monopolies is rapidly growing in favor in this country, as has been shown in these columns, especially in connection with water-works. It is also becoming evident to the public that such monopolies should yield to it a revenue, and that the effect of removing corporation influence in municipal politics lessens corruption, other things being equal, far more than the addition to municipal functions increases it. Where ownership does not prevail and taxation of revenue is adopted, strict public supervision of accounts is absolutely necessary or taxation will be avoided to a large extent. These points the author does not bring out so strongly as he does some others, while he practically ignores the possibility of regulating the rates of water, lighting and similar companies. Such a regulation is in some respects difficult, but is more practicable than the regulation of railway rates, and would go far toward solving corporation problems.

GEOLOGICAL SURVEY OF MISSOURI. A preliminary report on the Coal Deposits of Missouri, from field work prosecuted during the years 1890 and 1891. Arthur Winslow, State Geologist. Published by the Geological Survey, Jefferson City, Mo. 8vo., pp. 226, map and 131 illustrations.

POCKET COMPANION, containing useful information and tables, appertaining to the use of wrought iron and steel as manufactured by Carnegie, Phipps & Co.,

Limited, Pittsburg, Pa. For engineers, architects and builders. Edited by C. L. Strobel, C. E., M. Am. Soc. C. E., M. Inst. C. E., assisted by F. H. Kindl, C. E. 1892. Pocketbook form, 16mo, pp. 334, $2.00.

While this volume retains much of the matter contained in the edition of 1890, it has new features, chiefly as follows: A more methodical numbering of sections and indicating by blue and red colors the sections supplied in iron and steel; revised specifications for constructions in iron and steel are given. Very considerable space is devoted to Z bar construction and to the general use of iron and steel in modern high buildings. It is an exceedingly useful and handy book, ably edited and up to date.

THE ARTESIAN WELLS OF COLORADO AND THEIR RELATION TO IRRIGATION. Bulletin No. 16 of the State Agricultural Experiment Station, Fort Collins, Colo. By Prof. L. G. Carpenter. 8vo., pamph., pp. 28; illustrations.

With the exception of the wells in the San Luis basin Prof. Carpenter has previously described the wells of Colorado in the report on artesian wells prepared by the Agricultural Department in 1890. This report was noticed in Engineering News for Feb. 14, 1891, and abstracted at length in succeeding numbers. The information previously published is not repeated in this pamphlet, but some additional matter is given regarding the wells of the San Luis basin, some 2,000 in number. This basin is in Western Colorado, and its wells are generally shallow and have but little flow and pressure, but they can be easily sunk. Some of them cost only $25. In general, artesian wells have not yet been much used for irrigation in Colorado, but they seem likely to be so used there and elsewhere in the future, their use increasing with the value of water.

PERRIS IRRIGATION DISTRICT, CALIFORNIA. Report on Its Physical, Engineering and Business Problems and Conditions. By Wm. Ham. Hall. 2. Report on its Legal Status, by Wilson & Wilson. 8vo. pamph., pp. 74; two folding maps; two views.

ALESSANDRO IRRIGATION DISTRICT, CALIFORNIA. Do., as above. Pp. 62; two folding maps.

These reports are designed to present to financial men and investors the opinions of acknowledged authorities regarding the general character of the districts named and their legal status. There are now about 35 of these districts. They have voted to issue, in the aggregate some $15,000,000 of district bonds, all within a short time. These bonds form a new class of securities, and, as is natural, have not met with as ready a sale as they deserve. These facts, together with the numerous inquiries which have been sent to San Francisco bankers regarding the bonds, led to conferences between leading irrigationists and bankers in order to determine what could be done to advance the interests of irrigation districts. As a result of these conferences Mr. J. W. Nance, of Perris, Cal., President of the California State Association of Irrigation Districts, addressed letters to several leading San Fransisco bankers asking them whether in case the several districts should employ Mr. Wm. Ham. Hall, Consulting Engineer, to report on their districts these bankers, individually, would refer to Mr. Hall's report as authoritative whenever called upon for information regarding such districts. Of course, the bankers replied in the affirmative.

Up to Oct. 1, 1891, three districts, the Perris, Alessandro and Central, had engaged Mr. Hall to prepare reports in accordance with the above outline, and these reports had been supplemented by the opinion of Attorneys Wilson & Wilson on the legal status of the districts.

The above explanation, together with the sub-titles to the pamphlets will give a fair idea of the scope and purpose of these reports. In addition it may be said that both the Alessandro and Perris districts have contracted with the Bear Valley Irrigation Co. for a supply of water, the company delivering water to the distributing system of the Perris district, and through the distributing system of the Alessandro districts to the highest point of each 10-acre lot.

Each report is accompanied by two maps, one showing the distribution system of the district as completed at the time of the reports, each of which was made in the fall of 1891; and the other showing the location of the district in its relation to adjacent irrigated land. The cuts in the Perris report show wooden pipe lines in course of construction. Presidents Nance and the irrigation districts have done well to secure the publication of such reports, and especially well in intrusting their preparation to Mr. Hall.

A description of the works of the Alessandro district was given in Engineering News of Feb. 6, 1892, and some other information in our issues of Aug. 29 and Oct. 17, 1891. The methods of organization and powers of irrigation districts were stated in our issue of July 4, 1891.

REPORT OF THE RAILROAD COMMISSIONERS OF CALIFORNIA, for the year ending Nov. 1, 1891. Wm. Beckman, J. M. Litchfield, Jas. W. Rea, Commissioners. Paper, 8vo., pp. 268.

With the exception of a leaf devoted to the formal report and half a dozen pages of statistical tables, this volume is given up to the returns of railway companies and the proceedings of the Board in the hearing and investigation of complaints, about all of which seem to have been with regard to rates and facilities. The statistics of permanent way show only 37 iron bridges and 10 combination bridges on the 4,290 miles of railway in the state. There are, however, 1,473 wooden bridges and about 67½ miles of trestles. Evidently the state will furnish abundant employment to bridge manufacturers in future years. The cost of the coal burned on California railways is given as $6 to $10 per ton. The casualties for the year included 18 passengers, 49 employees, and 55 others killed, and 118 passengers, 470 employees and 145 others injured.

NEW ENGLAND ROADMASTERS' ASSOCIATION.—Proceedings of the ninth annual convention, held at Boston, Mass., Aug. 19 and 20, 1891. Paper, 8vo., pp. 110.

This is a complete report of the proceedings of the convention, which was noted in our issues of Aug. 22 and 29 1891.

WATER-WORKS REPORTS. The following reports have been received, the gentlemen named being superintendents unless otherwise stated:

Keene, N. H., P. F. Babbidge; Woodsville, N. H., Ezra B. Mann; Montpelier, Vt., Joel Foster; Fall River, Mass., Patrick Kieran; Middleborough, Mass., J. E. Beals, Water Commissioner; Northampton, Mass., J. M. Clark; New London, Conn., W. H. Richards; Waterbury, Conn., Welton & Bonnett, Engineers; Hudson, N. Y., P. Miller-Secretary; Schenectady, N. Y., Geo. T. Ingersoll; Bradford, Pa., H. D. Heffner; Longhorne, Pa., J. J. Broadhurst, Chairman Management Committee; Dayton, O., Chas. E. Rowe, Secretary; Saginaw, Mich., John F. Maher, Secretary; Ottawa, Ont., Robert Surtees.

TRADE PUBLICATIONS.

STEAM PUMPS AND HYDRAULIC MACHINERY. Catalogue and price list, to Jan. 2, 1892, of M. T. Davidson, New York. 8vo., pamph., pp. 115, with cuts and diagrams.

WATER METERS, AUTOMATIC REGISTERS AND WASTE DETECTORS, Henry Sporton & Co., Enfield, England. 6vo., pamph., pp. 38.

If the water meters illustrated in this catalogue are a fair sample of English practice, it would pay water-works superintendents there to send to America for their meters. So far as we know, little progress has been made in water meter construction in foreign countries during the past decade. In America, on the contrary, the water meter question or the question whether water meters were suitable for general use has become a question no longer, thanks to the perfected meters which have replaced the old fashioned types in use a dozen years ago. However, the automatic registers for recording the flow in mains which are described in this catalogue (a simple adaptation of the old rotary meter) are worth some attention. The water telephone, too, for detecting leaks by sound has done good service in the past, and can do it still on many water-works.

CONTRACTORS' AND QUARRYMEN'S MACHINERY, American Hoist & Derrick Co., St. Paul and Chicago, 8vo., pp. 104.

A great variety of derricks and horse and steam power hoists are illustrated and described in this catalogue. Among other things of interest we notice a novel vertical boiler in which the upper flue sheet is kept in contact with water; and at the same time ample steam space is secured.

CONTRACTORS' TOOLS AND MACHINERY, Brick Plants and Rolling Mill Machinery, Thos. Carlin's Sons, Allegheny, Pa., 8vo., pp. 187.

This catalogue shows a large variety of hoisting and portable engines, among which we notice a double cylinder hoisting engine with pulley attached, which should be a very convenient machine for a general contractor's use. The firm's stock of derrick irons and similar contractors' hardware deserves mention as being especially full.

THE MULTIPLE SPEED AND TRACTION RAILWAY, (Movable Sidewalk). Max E. Schmidt, Inventor and Chief Engineer. The Multiple Speed and Traction Co.; 4to., pamph., pp. 15; numerous large plates.

This novel project, which has been already pretty well described in these columns, and which we shall shortly illustrate, is shown in all its details in this pamphlet. We rejoice to learn that a considerable section is likely to be erected at the great Chicago Fair, and we see no reason why it should not be as successful as it is ingenious.

SOCIETY PROCEEDINGS.

QUARRY OWNERS' NATIONAL ASSOCIATION.—A meeting will be held at Chicago Feb. 25. Among matters to be considered are the following: The appointment of a measuring inspector for each city; the adoption of a uniform standard of measurement; the relation of quarrying and manufacturing machinery to the trade, and the relations of quarry owners to their agents. Pres., L. H. Malone, Cleveland, O.; Secy., B. A. McGee, Bloomington, Ind.

ENGINEERING ASSOCIATION OF THE SOUTH.—Meeting at Nashville, Tenn., Feb. 11, Vice-President Jas. Geddes presiding. The President of the Association, Mr. A. V. Gude, of Atlanta, invited the Association to hold the March meeting at Atlanta. The invitation was accepted, and Maj. J. W. Thomas, President of the N. C. & St. L. R. R., offered to furnish transportation to the members of the Association to Atlanta. The trip will be made by daylight in order to give the members of the association an opportunity to inspect the extensive improvements being made on the Western & Atlantic R. R., which has recently been acquired by the N. C. & St. L. R. R. Co. Mr. Olin H. Landreth spoke on the subject of "The Calorific Power of Southern Coals." One of the results presented was that a series of coal tests covering a large number of southern coals had developed the fact that there were at least three southern coals which were superior in calorific power to the standard second pool Pittsburg coal, and but slightly below Cumberland, Md., semi-bituminious coal. The paper was discussed by Messrs. Hunter McDonald, J. B. Atkinson, W. L. Dudley, J. S. Walker, W. G. Kirkpatrick and Gordon Hicks.

SOUTHERN SOCIETY OF CIVIL ENGINEERS.—Annual meeting Jan. 18, 1892, at Jacksonville, Fla., Mr. Bozeman, Vice-President from Alabama, occupied the chair. The paper on "Railroad Location," of Mr. Lynch, was read and discussed by Messrs. Duval, LeBaron and Gartner. Mr. Bozeman's paper on "The Improvement of Our Highways," was also read before the Society. Upon motion of Mr. de Bruyn Kops, a Standing Committee on Legislation was appointed, composed of Messrs. LeBaron, Duval and Prioleau. These gentlemen, at the close of the meeting, presented a bill for the licensing of surveyors and bridge inspectors, which will be introduced at the next session of the Florida Legislature.

The constitution and by-laws were revised at this meeting, making Jacksonville, Fla., the headquarters, and fixing upon the third Monday in January for the annual meeting, among other amendments.

The total membership of the society is 46 seniors and 12 juniors. Of these there are only 22 in good standing, having paid all dues and assessments as required by the by-laws. The following officers were elected for the ensuing year: President, Louis J. Barbot; Vice-President for Georgia, M. C. Kollock Vice-President for South Carolina, C. S. Phelps; Vice-President for Texas, M. L. Lynch; Vice-President for Virginia, F. L. Hoge; Vice-President for Alabama, J. E. Bozeman; Vice-President for Florida, R. N. Ellis; Secretary and Treasurer, J. de Bruyn Kops; Directors, J. F. Le Baron, Blair Burwell, A. Baur, W. C. Brown, J. G. Gibbes. The next annual meeting was ordered to be held in Savannah, Ga.

COMING TECHNICAL MEETINGS.

ENGINEERS' CLUB OF PHILADELPHIA.
Feb. 20. 1122 Girard St. Secy., J. C. Trautwine.
DENVER SOCIETY OF CIVIL ENGINEERS.
Feb. 23. Secy., Geo. H. Angell, Jacobson Block.
NATIONAL ELECTRIC LIGHT ASSOCIATION.
Feb. 23, 24, 25, at Buffalo, N. Y. Office, 18 Cortlandt St., New York.
QUARRY OWNERS NATIONAL ASSOCIATION.
Feb. 25. Chicago. Secy., B. A. McGee, Bloomington, Ind.
WESTERN SOCIETY OF ENGINEERS.
March 2. Secy., J. W. Weston, 239 La Salle St., Chicago.
ENGINEERS' CLUB OF ST. LOUIS.
March 2. Secy., Arthur Thacher, Odd Fellows' Building.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
March 2. Secy., F. Collingwood, 127 East 23d St., New York.
ENGINEERS' CLUB OF MINNEAPOLIS.
March 3. Public Library Bldg. Secy., F. W. Cappelen.
ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
March 4. Secy., E. K. Smoot, 803 Commerce St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
March 4. Secy., O. von Geldern, 819 Market St., San Francisco.
SWEDISH ENGINEERS' CLUB.
March 5. Secy., P. Valentine, At 231 Union St., Brooklyn, and 646 North 10th St., Philadelphia.
NORTHWEST RAILROAD CLUB.
March 5. Union Station, St. Paul.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
March 7. Secy., C. L. Annan.
ATLANTA SOCIETY OF CIVIL ENGINEERS.
March 8. Secy., Parker N. Black, Capitol Block.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
March 8. Secy., A. H. Porter, 50 Euclid Ave.
NORTHWESTERN SOCIETY OF ENGINEERS.
March 8. Occidental Block, Seattle, Secy., E. H. Warner.
NEW ENGLAND RAILROAD CLUB.
March 9. United States Hotel, Boston. Secy., F. M. Curtis.
ENGINEERING ASSOCIATION OF THE SOUTHWEST.
March 10. Secy., O. H. Landreth, Nashville, Tenn.
ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE.
March 10. Secy., Edward Mead, Norton Building.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
March 11. Union Station, St. Paul.
TECHNICAL SOCIETY OF NEW YORK.
March 12. 194 Third Ave. Sec., H. Schreiter.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
March 12. At Roanoke. Secy., J. R. Schick, Roanoke, Va.
ENGINEERS' CLUB OF KANSAS CITY.
March 14. Baird Building. Secy., H. Goldmark.
WISCONSIN POLYTECHNIC SOCIETY.
March 14. Secy., K. P. Neukom, Milwaukee, Wis.
WESTERN RAILWAY CLUB.
March 15. Rookery Building, Chicago. Secy., W. H. Marshall.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
March 15. Secy., J. H. Harlow, Pittsburg, Pa.
BOSTON SOCIETY OF CIVIL ENGINEERS.
March 16. Secy., S. E. Tinkham, City Hall.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
March 17. Secy., C. H. McLeod, Montreal, P. Q.
ENGINEERS' CLUB OF CINCINNATI.
March 17. Secy., J. F. Wilson.
SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
March 17. Secy., T. G. Philfeldt, 118 Adams St.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
March 17. At Atlanta, Ga. Secy., F. A. Charpiot, Macon, Ga.
NEW YORK RAILROAD CLUB.
March 17. Secy., H. G. Prout, 73 Broadway.
MONTANA SOCIETY OF CIVIL ENGINEERS.
March 19. Secy., F. D. Jones, Helena.
CENTRAL RAILWAY CLUB OF BUFFALO.
March 24. Secy., Jas. Macbeth.
AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
May 16 to 20. San Francisco, Cal. Secy., F. R. Hutton, 12 W. 31st St., New York.

ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

Published Weekly at Tribune Building, New York. Entered at the Post Office, New York City, as Second Class Matter.

VOL. XXVII. SATURDAY, FEB. 20, 1892.

D. McN. STAUFFER, A. M. WELLINGTON.....EDITORS
CHAS. W. BAKER, E. E. R. TRATMAN, M. N. BAKER, F. P. BURT, } ASSOCIATE EDITORS
GEO. H. FROST.....BUSINESS MANAGER

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ADVERTISING RATES, 20 cents per line agate measure. Schedule sent on request. Changes of advertisements must be in hand on Tuesday afternoon; new advertisements, Wednesday afternoon; transient advertisements, not later than Thursday noon. The last pages go to press early on Friday, and we shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.

In regard to the premiums offered by this journal for the best graduating theses in 1892, as announced in our issue of Jan. 30, a valued correspondent, a professor of civil engineering in one of our leading technical schools, writes us:

Your points are strong and well put, but there are some strong reasons why the competition you propose would not be a fair one. The time given to theses in all schools is not the same, some making a great point in that direction and others doing much less. Then again, any thesis is done under the direction of the professors, and often many of the ideas are due to their suggestions. In my own department I have had many theses that I should not feel justified in putting out as done entirely by a student on such a competition, because I should have conscientious scruples about letting my suggestions or my work in part go for his. I look upon the theses of my students as a piece of work from which I am enabled to judge whether the man has the ability to deal with an original problem, whether he can carry on a set of experiments, or carry out a research, or make a design, creditably. Now, in any school some part of any thesis is in some degree due to the teacher. You may get the finest thesis from some small school where there are two or three students in the class and where each one spends a third of his time on his thesis, and, moreover, where the teacher has time to get the theses into good shape, to superintend the experiments, or to look over the design carefully every day and make suggestions.

These thoughts have occured to me as showing that your competition may lead to incorrect and unfair judgments regarding the different schools, although you may attain your object of judging them justly on their merits as theses. Of course it is not necessary for me to compliment your paper, or to say that I fully agree with you in appreciating the advantage of having any technical article come out in such a journal.

The difficulties mentioned are real ones, and are perhaps hopeless obstacles to ideally exact judgments. Ideal exactitude is not expected, but only substantial justice to individuals. It is perfectly true that the amount of time which the student is encouraged or allowed to give to the preparation of a graduating thesis varies greatly in our technical schools, and may justly do so. Some of the best and largest schools attach comparatively little importance to the theses, and hence might, if premiums such as we have offered for the current year were continued yearly, lose some prestige in time from the fact that few or none of their graduates won premiums. But, after all, such loss of prestige to a college, if it should in fact exist, would be purely negative in its character and could do it no real harm. As respects the individual graduates, which is the more important matter, this negative form of injustice could not exist at all. To win a prize might be a credit; not to win it, when only three or four were awarded among nearly 500 graduated, could not be held to be a discredit, even if the man might, had he had a little more time, have been a successful competitor.

Our idea and expectation in making the offer was, as it still is, that the prizes would go almost exclusively to those who, favored by some exceptional opportunities for experiment, or previous experience, or decided bent of mind, or all these together, should succeed in producing a thesis which would be of interest to all engineers and a real contribution to knowledge (although perhaps not a great one) in its special department of engineering. It will not follow that the authors of these are the brightest men. It will by no means follow that theirs has been the most careful or thorough instruction. But it will follow, it seems to us, that the author of a thesis of this nature, though he may have received the usual hints and suggestions from his professors, will not have received so many as to make it the professors' work rather than his own. It is the duller or less mature men only, whose work is largely perfunctory, who are likely to lean upon their professors to such an extent as to make their theses his work rather than their own.

The rapid transit situation in New York is outwardly unchanged, but there are some signs that a scheme with much influence in its favor, and we may add with many strong arguments in its favor, is coming to the front. The weakest points of the late rapid transit report were (1) the diversion of the proposed east-side line into Madison Ave. above Forty-second St., and (2) the concentration of two four-track trunk lines, the east side and west side, upon a single four-track trunk down Broadway, which latter would have nearly enough local business of its own to keep it fully occupied without any aid from either of the uptown lines.

We did not comment at the time on these or any other of the dubious points of the report, because we were anxious to throw no straw in the way of the prompt beginning of the work; but we did not then, as we do not now, believe that either of these recommendations were made with any expectation that they would materialize in construction. Motives of policy only dictated them, in our belief. To try to carry the traffic of eight uptown tracks on four Broadway tracks, except on paper, or as a temporary expedient, would be an act of great folly. A very little study of the situation will indicate that for several reasons the west side line only should throw its trains upon the Broadway line, and that the east side line should continue on down Centre St. or the Bowery to the City Hall at least. To construct an underground or any other rapid transit line up Madison Ave. would be an act of equal folly. It would ruin the second best residence street of the city. It would get next to no traffic from the west, since Central Park is only a short block west. It would leave the really heavy traffic far to the east. It would leave unused an avenue (Fourth Ave.), which has already been made extra wide for rapid transit purposes, on which property has been already more or less depreciated by the existing tunnel line under it, and on which plenty of room exists for adding four more tracks above those now existing without much further injury to property.

Keeping all these facts in view, we suspect that the true inwardness of the rapid transit situation is now beginning to come to the surface. An uncommon anxiety is now being exhibited in certain quarters, which have been known before now to be inspired "to have the Central forced" to permit the opening of its tunnel up Fourth Ave., and the construction of four more tracks for rapid transit use above its four present tracks, which would then no longer be in tunnel, but merely sunken, as would also be the four tracks over them for most of the length where all eight tracks would not be on a high viaduct. Below Forty-second St. the announced outlines of the scheme are a little hazy. There is some natural talk about continuing thence "through the blocks" to somewhere. That always sounds well.

But it needs no great perspicuity to see that a dose of the same medicine which is proposed for the district above Forty-second St. would cure all rapid transit ills between Forty-second St. and Union Square, and that thence it is but a short step through a broad unoccupied street and "through the blocks" to Centre St. or even over to the Bowery, where there is plenty of room for a two-story four-track structure in the middle of the street, quite independent of the two existing tracks over the sidewalks. After the tracks had reached the City Hall by either of these routes, some money might have to be spent to get proper underground terminals or to extend the line further down town, and it could well be afforded.

As we have said, there are many strong arguments in favor of such a scheme as this. It is an attractive scheme for investors. It would injure property much less than any other non-tunnel line which can be devised. It would benefit the public, and especially the Harlem and "annexed district" public, more than any other four-track route which can be devised, and vastly more than the Madison Ave.-Fourth Ave.-Broadway route which the commission has proposed to "accommodate" the east-side traffic—with its tongue in its cheek, we cannot but believe.

There can be no doubt that the action of the Master Car Builders' Association in appointing a committee to formulate requirements for an acceptable automatic air brake is a move in the right direction. While the Westinghouse Brake Co. had the field to itself, its interest in maintaining the reputation of its brake was such that there was little danger of unsafe or inefficient brakes going into service. But at the present time the New York Air Brake Co. is vigorously competing for orders; the Boyden Co., of Baltimore, claims to be doing some work; and there are prospects of competition from two or three other directions. Of course every new competitor will have to attract business by making large reductions in price; and even granting that the principle of his device is all right mechanically, the tendency will be to lower the quality of the work in order to avoid loss.

The possibility or probability of legislation by Congress making equipment with automatic air brakes compulsory, increases the need for some authoratative standard by which a new brake may be tested. Without something of this sort a certain class of railway companies will be apt to adopt the cheapest brake they can find which conforms to the letter of the law, with little regard to its reliability. Certainly action of this sort cannot be permitted by the railways of the country. Brakes which are acceptable in interchange and those which are not must be sharply defined. The danger in running trains equipped with unreliable brakes is too apparent to need proof.

The committee appointed to formulate requirements for an acceptable automatic air brake consists of Messrs. G. W. Rhodes, Geo. Gibbs and E. B. Wall. A meeting of the committe was held at Burlington, Ia., during the recent brake tests, and the plans proposed by the committee were informally discussed by many of those present at the tests. It was generally agreed that a time limit for the starting of the brake piston on the rear car was the first essential, and also a limit at which full pressure must be reached there. 3 seconds and 4½ seconds were suggested as these limits on a 50-car train, measuring from the movement of the engineer's valve. The questions of standards for release and for acceptable work in service stops present much more difficulty. There was considerable discussion as to the desirability of interposing some check upon the use of the emergency application, on account of the injury done to rolling stock by its frequent use. It was even proposed to seal the emergency and require good reasons to be given when the seal was broken. It was very properly objected, however, that any check of this sort was likely to lead to an increase of accidents. Another suggestion was to decrease the pressure of the emergency application. This would have the disadvantage that cars now equipped with brakes would not work well with cars having a lower cylinder pressure in an emergency stop.

The committee proposes to make a preliminary report, which will be published for general discussion before the final standard is reported. Their task is as difficult as it is important, but it is in excellent hands and the result of their labors is awaited with interest.

The Russian famine which, according to the best authorities, involves a population of about 20,000,000 souls, may be traced to this or that source, but it is

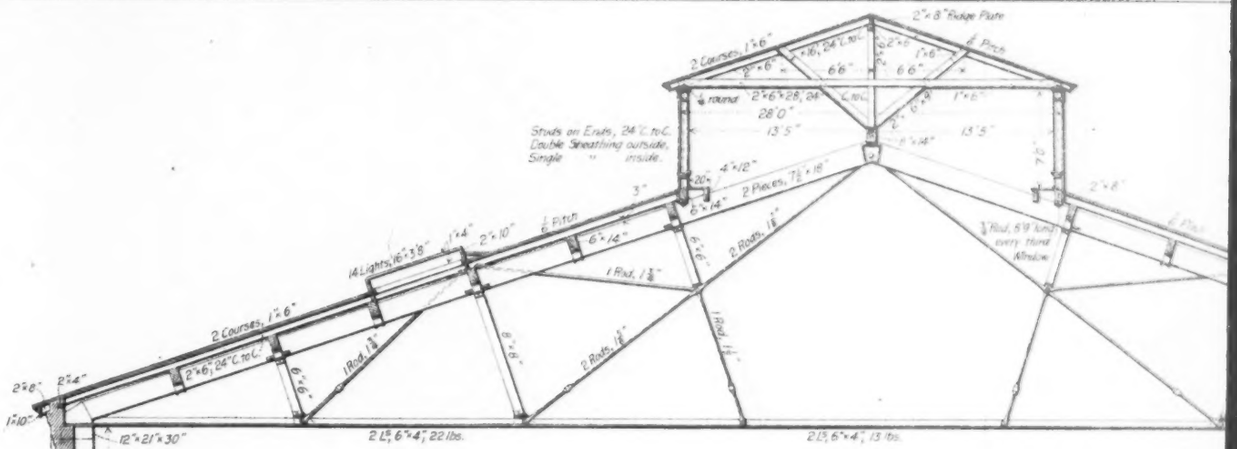
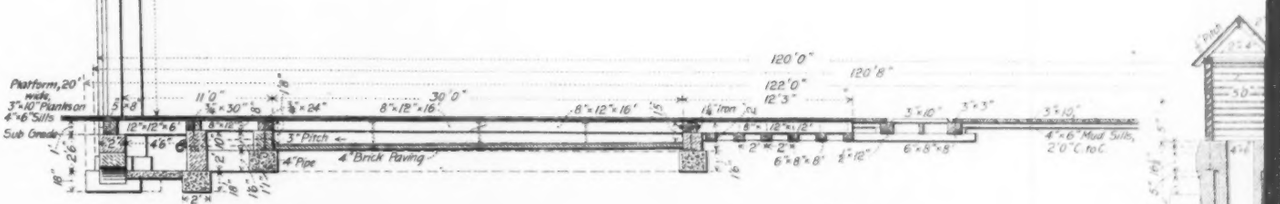


FIG. 7. MACHINE SHOP.



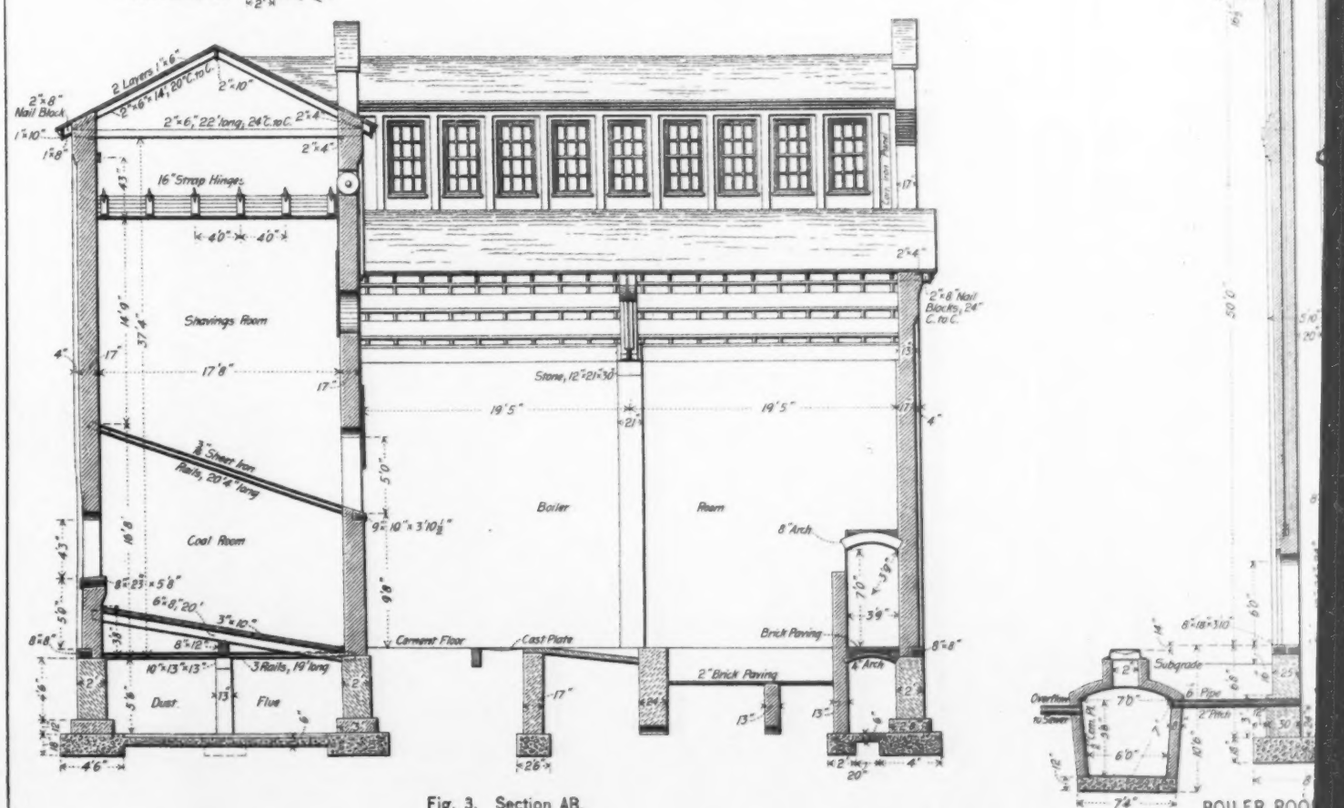
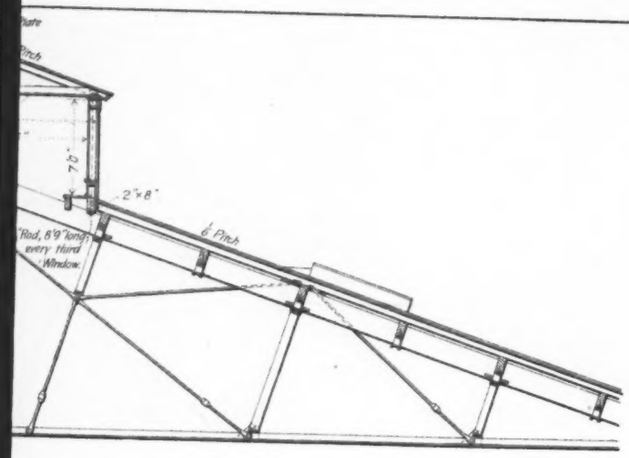


Fig. 3. Section AB.

BOILER ROO

NORTHERN PACIFIC RAILROAD SHOP



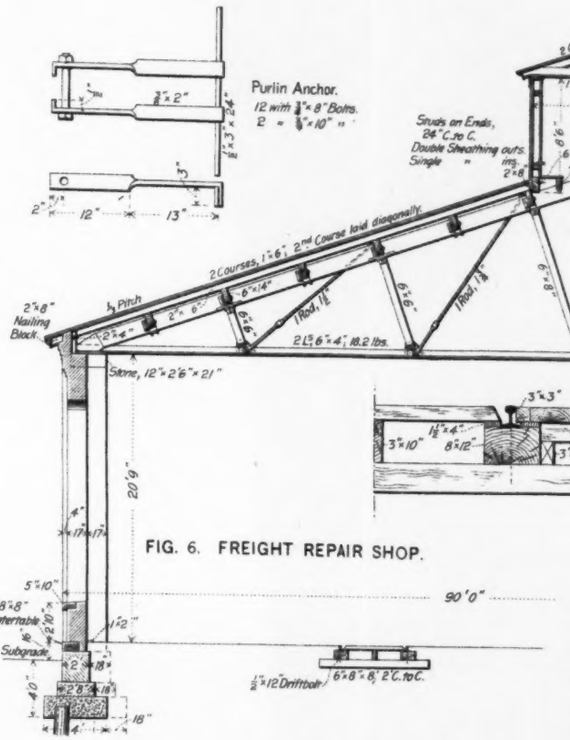


FIG. 6. FREIGHT REPAIR SHOP.

Fig. 2. Plan of Shaving Tower, Etc.

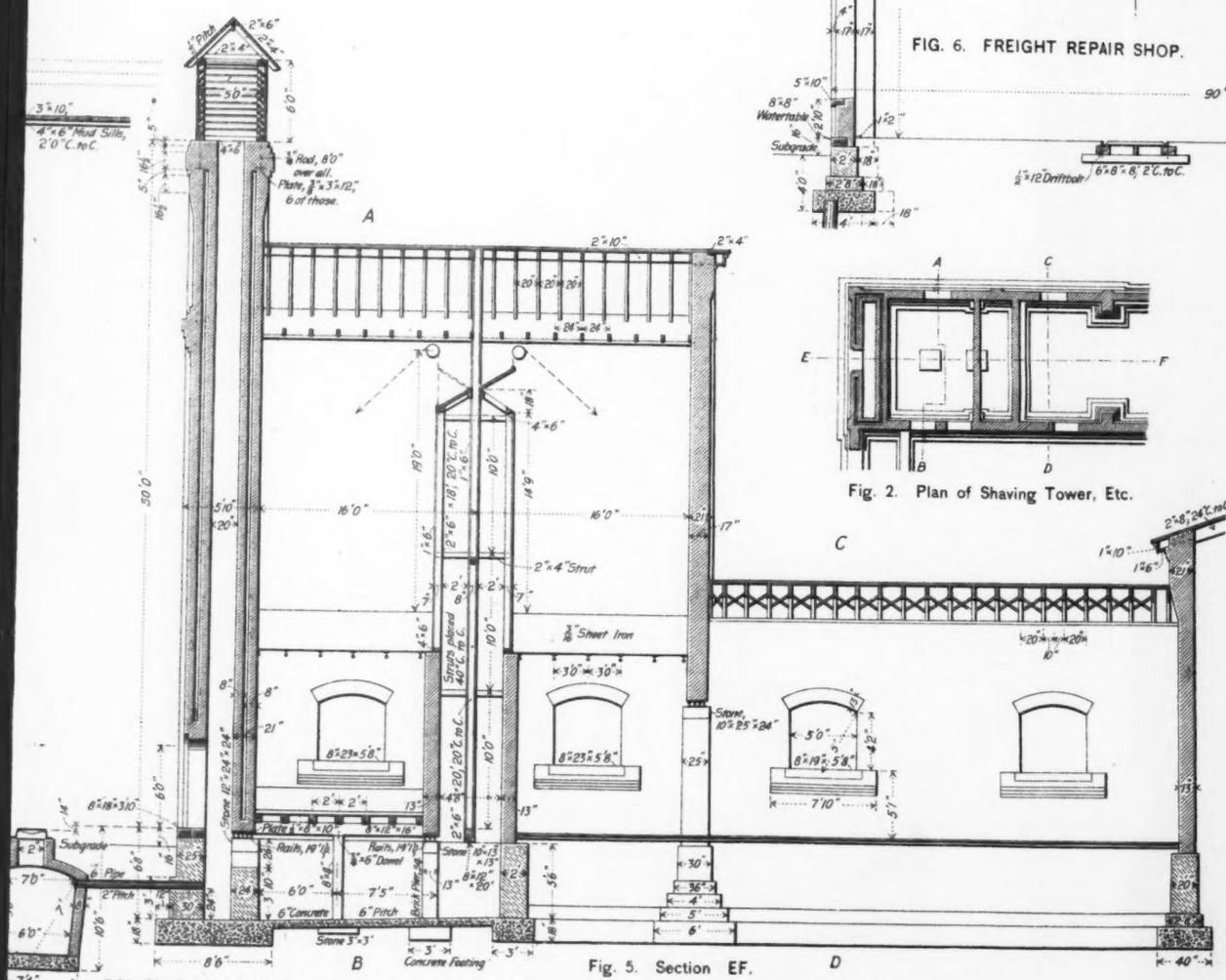
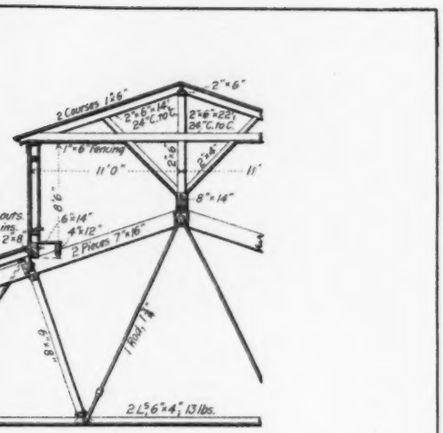
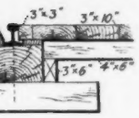


Fig. 5. Section EF.

BOILER ROOM, SHAVING TOWER AND COAL ROOM.

RAILROAD SHOPS AT TACOMA, WASH.; J. W. Kendrick, Chief Engineer.





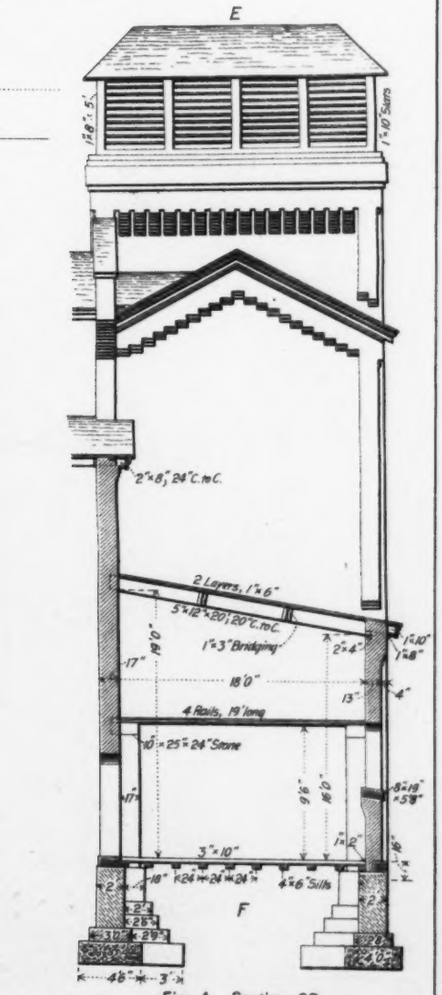


Fig. 4. Section CD.

CHAS. HART & SONS, LITH., 25 VESEY ST., N. Y.

a fact worthy of especial note that it would have been practically impossible, or at least its severity would be greatly mitigated, were Russia provided with even a moderately complete system of railways. European Russia contains 60 provinces, and in 22 of these the harvest this year, owing to a prolonged drought, was nearly, or quite, a total failure. Yet in other provinces the harvest was fairly good, and were ample means of internal communication available—were there even decent common roads—the starving peasants might be succored with far greater ease and certainty.

With a total area of 2,095,504 sq. miles, and a population of 95,870,810, European Russia has only 17,504 miles of railway, or one mile of railway to each 119 sq. miles of territory and each 5,450 inhabitants. Its average density of population is 44 per square mile; but of the total area, 650,000 sq. miles, or about one-third of the whole, has only 1 to 19 inhabitants per square mile. The population, therefore, of the settled portion of European Russia is probably between 60 and 70 per sq. mile. For comparison it may be said that the population of Virginia is about 40 per sq. mile, and that of Indiana is about 60 per sq. mile, The former state has one mile of railway to every 12 sq. miles of territory, while the latter has a mile of railway for every 5.66 sq. miles of territory. These figures enable us to appreciate in some degree the difficulties of transportation in Russia, with only 1 mile of railway for every 119 sq. miles of territory, a condition of affairs only paralleled in this country by the state of Nevada, with its sage brush and alkali deserts.

When it is realised that all the food consumed by a dense population in several provinces must be transported hundreds of miles, and that the winter seals up the Volga and its tributaries, which are the great arteries of communication in summer, the burden of traffic which comes upon the railways in southern Russia at this time can be appreciated. The main difficulty in transportation, however, is between the railway stations and the remote districts,some of them a hundred miles or more from railway and telegraph communication. During the early part of the winter, the highways were well nigh impassable, which added greatly to the difficulties of those engaged in the work of relief. A snowfall sufficient to furnish good sleighing, however, has for the present made this work somewhat easier.

RAILWAY ACCIDENTS TO PERSONS.—II.

The train mile is the fairest of all single units for comparing casualties to persons, when the end in view is to judge of the comparative excellence of the provisions to insure safety. As respects casualties to employees or to trespassers this is perfectly obvious. Most of the casualties happen about the head or the rear of the train, regardless of length. Even collisions or derailments usually affect only a few cars at head or rear. The consequences may be a little more serious if the train is heavy than if light, and coupling casualities and falling from trains will be more frequent per train mile with long trains than with short ones, for no one unit can be perfectly equitable in its application. But when we compare these chances with those which favor the train mile unit, the balance is overwhelmingly in favor of the latter for any comparison of aggregates.

Conceive, for instance, a given traffic handled on one road with twice as many trains as on another. It is evident that with equal skill in management it might expect to have nearly twice as many casualties to employees and trespassers at least. For comparing different roads, sections or countries, therefore, the train mile furnishes a very satisfactory unit of comparison (supplementing it occasionally with other units for special classes of casualties), it being only necessary to bear in mind that such unit slightly favors the road or country running the lightest trains.

As respects passenger traffic it is almost equally clear that casualties may be expected to vary much more nearly with the passenger train miles than with the number of passengers in the train. The risks cluster about the head and rear of the train, and are not largely increased by two or three cars more or less in the middle of the train. With a given traffic carried in 2,000 4-car trains the risks are pretty nearly double what they would be with 1,000 8-car trains.

In like manner, passenger risks are heavily increased by the freight traffic, not only as respects collisions, switch derailments, etc., but in other ways. Conceive three roads running an equal number of passenger trains, one of them with no freight trains, another with an equal number of freight trains, and the third with twice as many freight trains. It is obvious that the chances of casualty would be greatly affected by the difference in volume of freight traffic, yet the passenger mile unit, or passenger train mile unit, would take no account of this difference; and still less the absurd unit so largely used in England (for lack of any record of miles traveled by passengers), viz., number of passengers.

Therefore, even for passengers, the total train mile unit is perhaps the fairest of any single unit for comparisons of casualties, with the further great advantage that it is equally applicable to passengers, employees and trespassers or others. But the ultimate question which most interests the public (though it does not give the best gage of operating efficiency) is: How many miles must a passenger travel to be killed or injured? We shall therefore begin with that unit, in the form of the comparative number of passengers killed and injured from various causes per 10,000,000,000 (ten thousand million) miles of passenger travel, that vast distance lacking but a little of being the total traveling done in a year in the United States, as will be seen by referring to the table given in our last issue, and being about 108 times the distance from the earth to the sun.

The following is the primary division of passenger casualties in the eight different records which we are comparing, viz., between casualties arising from accidents to trains and from all other causes.

Table III.—Casualties to passengers per 10,000,000,000 passenger miles:

	Total.		From train acc'ts.		Other causes.	
	Killed.	Inj'd.	Killed.	Inj'd.	Killed.	Inj'd.
No. U. S.	223	1,540	60	710	153	830
So. U. S.	323	3,455	188	2,181	135	1,274
W. U. S.	267	2,510	129	1,704	138	796
New York	110	534	47	286	63	248
Mass.	180	820	[D't'ls not deducible from r'p'ts.]			
Gt. Britain.	201	2,316	31	794	170	1,522
Germany	83	271	25	173	58	98

As shown last week, New York's figures are the totals for two years and Massachusetts' for five years, so that each line represents results from a large and approximately equal quantity of traffic. From the Massachusetts casualties the exceptional Bussey Bridge disaster is omitted. The English passenger mileage was computed by allowing 7.2 miles of average travel to each passenger, as deduced in Mr. E. B. Dorsey's paper on "English and American Railways Compared," that figure having been quite generally accepted as substantially just.

It must be admitted that, especially after a correction below noted has been made, Table III. makes anything but a bad showing for this country. The traffic in the Northern U. S. only is carried on under conditions fairly comparable with Great Britain's, and it will be seen that, though the deaths are slightly more, the injuries are much fewer* than in Great Britain, per 10,000,000,000 passenger miles. New York and Massachusetts compare still better. Germany shows best of all, but, as stated last week, German traffic is carried on under too dissimilar conditions to have the comparison of more than casual interest.

The number of separate passengers, represented by the assumed passenger mile unit, varies considerably in these different localities, representing in Great Britain about twice as many as in Germany, and over five times as many as in our West and South. The average haul or passenger trip in miles in each country or group is as follows:

No. U. S.	So. U. S.	W. U. S.	N. Y.	Mass.	Gt. Britain.	Germany.
18.7	36.9	38.8	18.2	14.9	7.2	17.6

That the above table demands a further correction in some items will become immediately evident from the following subdivision of the "Train Accident" aggregates in Table III.

Table IV.—Passenger Casualties from Accidents to Trains per 10,000,000,000 Passenger Miles.

[This table is a subdivision of the second pair of columns in Table III.]

	Collisions.		Derailments.		Other train accidents.	
	Killed.	Inj'd.	Killed.	Inj'd.	Killed.	Inj'd.
No. U. S.	30	365	13⅓	215	16⅔	130
So. U. S.	9	619	108	1,257	72	305
W. U. S.	57	531	42	950	30	223
New York	43	223	..	43	4	20
Mass.	[Details not deducible from state reports.]					
Gt. Britain.	31	709	..	32		53
Germany	25	148	..	25	..	..

It will be seen at once in Table IV. that New York, Great Britain and Germany have almost no casualties from "other" train accidents (other than collisions and derailments). We shall manage later to get an equally clear indication of the same fact from the Massachusetts returns, when we get to something which is deducible from the regrettably imperfect reports of that State. That there should be few of these "other" casualties is as it should be, there being only a few possible causes, like boiler explosions, car on fire, projecting freight car doors, etc., by which an accident to a train other than collision or derailment can cause injury to persons.

In the figures taken from the interstate statistics, however (those for sections of the United States), quite a large number of such casualties appear. Most of these beyond question are misclassifications, persons injured by trains being wrongfully classed in as injured in "other accidents" to trains, when they were really only accidents to persons caused by trains. The error is probably made in filling out the original blanks and not in the statistician's office, but until it can be corrected the statistician's annual reports will not have the value they should have.

An interesting and highly important fact is readily discernible in Table IV., and will be quite as readily seen in other tables yet to come. In the Northern United States, New York, Great Britain and Germany derailments are becoming of trivial importance as compared with collisions. In the South, with its few trains and much poor track, it is the other way. The west is betwixt and between. The moral deserves to be written in letters of gold over every operating officer's desk: "When track is once brought up to the east of Chicago, British and German standard, derailments of serious moment tend to become evanescent!"

How much greater the risks of passengers are from other causes than from train accidents may be shown from the following little table (V.) of percentages, in preparing which we do not include the "other" train accidents of the interstate groups with the train accidents but with the "other causes," where most of them belong:

Table V.—Percentage of Deaths and Injuries of Passengers from Train Accidents and from Other Causes.

	Train Accid'ts.		Other Ca'ses.	
	Killed. Per c't.	Injured. Per c't.	Killed. Per c't.	Injured. Per c't.
No. United States	29	38	80	62
So. United States	36	54	64	44
W. United States	37	59	63	41
New York	43	54	57	46
Massachusetts	[D't'ls not deducible from r'p'ts.]			
Great Britain	15⅓	31	84⅔	66
Germany	30	64	70	36

Few persons have any idea that there are other causes which are so much more fatal to passengers than all train accidents put together. It is of interest to see what those causes are. They are shown with all the detail which is now possible in Table VI.

Table VI.—Causes of Casualties to Passengers Other than Train Accidents.

	Per 10,000,000,000 passenger miles.					
	Falling from trains or getting on or off trains in motion.		At stations, crossings or being on track.		Other causes.	
	Killed.	Inj'd.	Killed.	Inj'd.	Killed.	Inj'd.
No. U. S.	....	....	50	326	103	504
So. U. S.	....	....	27	448	108	826
W. U. S.	....	....	22	215	116	561
New York	47	201	12	2	4	14
Massachusetts	[Not determinable from State reports.]					
Great Britain.	24	257	99	1,582	48	184
Germany	....	....	58	98	....	....

This table calls for several explanations. The first three lines of the first two columns are vacant simply because the interstate blanks have no line for casualties to passengers or "others" due to falling from trains or getting on and off trains in motion. Many, if not most, of the casualties charged to "other causes" in the first three lines of the last two columns of Table VI. really belong here.

In New York state over two-thirds of the casual-

*This is doubtless in good part due to greater care in reporting British injuries, but after allowing for this difference the fact would seem to be as stated. It is to be noted that the state reports of injuries seem to be quite defective.

ties recorded in the first column were due to getting on and off trains in motion, and the remainder to falling from trains. The totals for two years were 14 killed, 72 injured for "getting" off, against 9 killed, 27 injured for "falling" off. The distinction is so fine a one that the exactitude of the returns may be reasonably doubted.

In Great Britain 200 of the 257 injuries in the first two columns were from passengers being injured by the closing of the doors, a kind of risk for which we have no parallel in this country, and which accounts for about 10 per cent. of all the British injuries to passengers.

Considering the next two columns, casualties to passengers at stations, crossings, etc., in every case the casualties at crossings or from being on track are an insignificant element, and practically all the casualties are at stations. It will be seen by comparing Tables III. and VI. that in Great Britain and Germany these station casualties are several times more numerous than train casualties and are the principal source of injury to passengers. In this country, contrary to what might be expected, these station casualties seem to be rather fewer than abroad, in spite of our free and easy ways at stations.

The casualties to passengers per 100,000,000 passenger train miles and per 100,000,000 total train miles are shown in the following Table VII. It will be seen we compare extremely well with Great Britain and Germany, considering all the differences of conditions, and considering especially that the enormous aggregates of short haul and all but perfectly safe travel on the elevated lines is not included with the railway traffic of New York and the Northern U. S., while the corresponding London local business it is included with the British traffic.

The ratios of killed to injured indicate that our returns are about as trustworthy as those abroad in their returns of injured. The average passenger train load, given in the last column, is an element to be considered in studying the first four columns of the table, as it is evident that the larger the average passenger train load, the larger the casualties per 100,000,000 train miles will naturally be.

Table VII.—Total casualties to passengers from all causes.

	Per 100,000,000 train miles.		Per 100,000,000 passr. train miles.		Av. pass. haul, miles.	Ratio killed to injured.	Av. pass. train load.
	k'l'd.	inj'd.	k'l'd.	inj'd.			
N. U. S...	40	291	96	699	18.7	1: 7.25	45.4
S. U. S...	43	455	113	1.208	36.9	1:10.67	35.0
W. U. S.	38	357	100	942	38.8	1: 9.40	37.9
N. Y. S'te	23	112	56	273	18.2	1: 4.86	52.5
Mass.....	51	241	91	423	14.9	1: 4.69	65.5
G't Br'tn.	38	438	71	815	7.2	1:11.50	35.3
Germany.	28	92	..	...	17.6	1: 3.28	....

This is well illustrated in the case of Massachusetts. Although, as elsewhere stated, the casualties of the very exceptional Bussey Bridge disaster (24 killed and 100 injured) have been deducted from the Massachusetts record, another unusually fatal disaster at Bardwell's Ferry, April 7, 1886 (11 killed, 29 injured) is included in the period averaged, and increases by nearly 25% the Massachusetts average. It is evident that the total casualties in this disaster, in which almost every person on the train was killed or injured, were directly increased by the Massachusetts tendency to large train loads.

That the United States stands so nearly on an equality with Europe in safety of passengers, in spite of our little use of the block system and other minute precautions and restrictions which surround the passenger abroad, we take to be chiefly due to three facts: (1) the solid construction of our rolling stock, which makes it very hard to injure in an accident; (2) the universal use of the best type of air brake; (3) the "bogie" type of running gear, which reduces the evils of imperfect track, and (4) the self-reliant watchfulness of our passengers, which comes in part from the habit of much travel. These causes should in the end give us even safer travel than in Europe, when our tracks, signals, etc., have been advanced to equality with the best European practice.

We will now take up the casualties to employees and "others," which we shall find to greatly exceed in numbers those to passengers, and in which we by no means compare so well with European experience.

THE OWNERSHIP OF EMPLOYEES' INVENTIONS.

It is a matter of more or less interest to thousands of engineers and others who are either employees of railways or officers over employees, to know what are the rights of inventors, and of the corporations or firms employing them, in regard to inventions which may arise more or less directly from the discharge of an employee's regular duties for which he is regularly paid. Has the employer any legal or moral claim upon inventions originating under these circumstances? A correspondent, whose letter has suggested this article, thus states the point at issue in a letter to the editor:

Will you please give me any information known to you as to the usual practice where an employee makes inventions while working on the time of a corporation; the said employee not being called "inventor" and there being no stipulation as to his inventive genius having been considered or engaged by the company?

What I want to know is, is it obligatory on such an employee to assign to the company he works for all rights in any such invention (because he took part of their time in improving it) without any remuneration? Have not Court decisions been made to the effect that a man cannot dispose of that which is not his at the time, *i. e.*, can make no disposition of future possibilities? However this may be, in the case now at issue no agreement of the kind was made.

As we understand the matter, the case stand sthus: A man may be, and often is, specifically engaged to make certain investigations in behalf of an employer, either for the use of that employer only, or to aid an employer in perfecting an invention. In the latter case the absolute ownership of all results of the employee's investigations of the particular points which he was instructed to investigate will vest in the employer, however unexpectedly valuable these results may prove to be. The employer, it is true, cannot himself take out a patent for an invention which is in part or whole the invention of another, whether an employee or not. The law is mandatory that the application must be in the name of the actual inventor, or of the joint inventors, if there be more than one, and that the patent will issue in his or their name. But if it be shown that this inventor was employed for the express purpose of making or perfecting an invention, the employer can compel the employee to assign to him the patent when issued, without further consideration.

In many cases the line as to what the employee was employed to do, and what not, may be very difficult to draw, and the line could only be drawn authoritatively by an appeal to the courts. A man, for instance, might be employed to experiment upon and perfect a new smoke-burning device, and, in doing so, might invent a mechanical method of stoking, which would be a great aid to the smoke burning features. Would the stoking device belong to the employer, or would it not? It would be a question which only a court could decide authoritatively, and the decision would probably turn upon the question whether or not the chief value of the stoking device was for the prevention of smoke. If it was, it would belong to the employer. If it was not, but was chiefly valuable for saving the labor of firemen or securing better consumption of fuel, the ownership would vest in the employee solely, even though the device might have some incidental effect to aid in the better combustion of smoke. In any case, the issue would be only one of fact, whether or not the improvement was of the class which the inventor was employed to make, if possible. There is not the slightest doubt that every man has, by a prior agreement of this kind, full right and power to "make disposition of future possibilities" in respect to his powers of invention, and to agree for a present consideration, to do what he can for another in that line.

But instances where a man is specifically employed to invent or help invent are of rare occurrence. The more usual case is that an employee in the discharge of his regular duties conceives the idea of an invention, and tries it or perfects it in the time of the employer, or by availing himself of his employer's facilities.

In this very common case, as we understand it, law, justice and common practice correspond; and what that practice is may be best exemplified by what is now the settled rule on the whole Pennsylvania Railroad system.

The practice of that road, of which any employee can avail himself if he choose, as some do almost every year, is that, if an employee make what he believes to be a good invention or improvement, he may, if he choose, submit it to his superior officers with a request that it be tested, or that facilities for perfecting it be granted. If his superiors approve the device or recommend it for trial, the established rule is that the company shall bear the expense of taking out the patent, and the inventor for his part shall give the company a free license to use the device on its lines, or in its shops. The same practice is more or less formally followed by dozens of other railway and private corporations.

This is generally regarded as a mutually advantageous arrangement, but there is nothing to compel the inventor to accept it if he does not choose. He can, if he prefer, find his own facilities for experiment, or take out his patent without prior experiment, and thereafter persuade the company to adopt it and pay him royalty. It is the settled rule of the Pennsylvania Railroad, we believe, to pay royalties in no case whatsoever to any employee for an invention made while in its service; but doubtless cases might arise when they would pay royalties to former employees who had left its service for the very purpose of guarding this right, though no railway very readily consents to pay royalties of any kind.

As we understand it, this practice outlines the respective rights of employers and employees in all such cases, in the absence of specific agreement to the contrary. Failing prior contract, in no case can an employer claim any full or partial ownership of an employee's invention, even when that employee has surreptitiously or openly availed himself of time or facilities belonging to his employer in order to make or prove his invention. The only valid claim the employer will have (if even that) will be for compensation for time or material thus surreptitiously diverted from his service. On the other hand, any device which an inventor has, with or without an employer's consent, applied to that employer's use, belongs to that employer, and no subsequent patent will alter this status.

An employee, for instance, might be instructed to put the shafting of a large shop in order, and in doing so "conceive the idea" of an improved hanger. It is at the option of the employer to permit him to try this device: (1) Without other consideration than the benefit to his shop which may result from it, or (2) only in consideration of a part interest in the patent, or (3) of granting full ownership, or (4) for any other more or less valuable consideration. Any prior agreement of this kind, if proved, will hold. But if the employer simply says "Go ahead and try it," and the employee does so, what the employer will own will be only the right to continue to use the device in his shop, and what the employee will own is all other rights which a patent can give. The same will be the case, as we understand it, should the employee surreptitiously apply the device, in order to test it, without the employer's knowledge or consent. Unfair as that would be, the employee forfeits no rights in his invention by so doing, as respects the rest of mankind.

We speak with some reservation, as this journal does not assume to be an authority on points of the law; but the general aim and purpose of the law seems to be clear, to protect the actual inventor in the enjoyment of his rights, and to permit no man whatsoever, whether employer or not, to enjoy the fruits of his ingenuity, without proving a specific contract to that effect. The employer does not own the man. He owns only his services for the specific purpose for which he was engaged under the specific conditions for which he contracts to work, or under which law or custom requires him to work. The law looks with suspicion upon the claims of an employer to own an employee's invention on the strength of such employment. The burden of proof is against him, and the only possible proof is an implied or actual verbal or written contract. There are many instances on record where employers have unjustly deprived employees of the fruits of their talent. There are few or none where the reverse has been true.

The Brooklyn Bridge Board of Trustees has adopted a resolution authorizing the Chief Engineer to extend the block system over the bridge. No action has yet been decided on.

Harvard University will commence its first summer course in field engineering on July 6, to continue six weeks. It is intended to give about 8 hours a day to field and office work, including lectures. The course in railway surveying will require a previous knowledge of, and familiarity with, surveying instruments and the elementary principles of plane surveying. The fee for each course is $25 and the total probable expenses range from $60 to $90. For circulars describing these and other courses apply to the Secretary of Harvard University, Cambridge, Mass.

The enormous increase in breadstuff exports continues. In January, 1892, they were over 30 millions in value against less than 10 millions the year before. For the 7 mos. ending with January, they were $186,136,474 against $64,524,799 the year before. The increase is great with all kinds of breadstuffs. Barley has increased from $233,000 to $1,309,000; corn from $10,000,000 to $19,000,000; oats from $327,000 to $2,688,000; oatmeal from $173,000 to $362,000; rye from $203,000 to $8,321,000; wheat from $24,000,000 to $113,000,000; and wheat flour from $29,000,000 to $41,000,000.

The Traction Co., now controlling the chief street railway lines in Philadelphia, wants to operate the Girard Avenue line by the trolley system. It is stated that they are willing to place the poles in the middle of this 100 ft. avenue, maintain electric lights on the top of each pole, and repave the street from curb to curb with Belgian blocks in return for the privilege sought. This would be the first application of the trolley system within the limits of Philadelphia.

Some improvements in English railway management are suggested by the "Railway Press," London, as fit subjects for consideration by the Railway Clearing House. Three of the points mentioned are: (1) the much higher first and second-class rates charged by the lines south of the Thames, in one case 5 cts. per mile for first-class fare as against 2.75 cts. on the northern lines; (2) the intentional failure of some railways to make their trains connect with those of others, thus putting through passengers to considerable inconvenience; and (3) the primitiveness of the cars of some railways, for which the same rates are charged as for the better accommodation of other lines. It is suggested that these and similar matters be put under the control of a committee of the Railway Clearing House.

Sparks from locomotives are rarely the cause of fires in England. In a recent suit against the Great Western Railway for the burning of hay ricks, the engine was shown not to have been equipped with a spark arrester, but the company claimed that it had used every reasonable precaution by the use of special contrivances, viz., a brick arch, a smoke deflector plate, and tubes of small diameter. Expert evidence was to the effect that spark arresters are in use on certain English railways, but are not looked upon with favor and are going out of use. The verdict was for the company. During the three years, 1888, 1889, 1890, the Great Western Railway trains ran 100,000,000 miles, and there were but six claims for damages due to sparks, only two of which claims were substantiated. A somewhat similar case, but with a different verdict, was noted in our issue of Oct. 24, 1891.

The Birmingham (England) Compressed Air Power Co. has finally gone into bankruptcy, after some years of rather unsatisfactory working. It is stated that only 30% of the power absorbed at the central station was delivered at the motor, also that there was excessive leakage in the mains. Heating the air before using it in the motor does not seem to have been in use, which was certainly unfortunate for the company's success. The Popp compressed air plant in Paris, however, is continually being enlarged and extended, notwithstanding the competition of electric power, and has proved a success in every respect.

The production of the mines of the earth for the year 1888 is estimated by the "Deutsche Kohlenzeitung" at $1,776,040,000. The value of the coal produced in that year is estimated at 40% of that amount, or $682,400,000. The following tables refer to coal production only, and we presume have been carefully compiled and computed:

	Area of coal regions, Square miles.	Coal production in tons.	Av. exp. per ton,
United States	189 429	132,548,844	$1.61
England	12,741	169,935,219	1.27
Germany	11,970	81,873,848	1.16
Russia	11,027	4,580,223	1.60
France	2,155	22,602,894	2.06
Austro-Hungary	1,004	23,647,000	1.05
Belgium	520	19,218,481	1.69
Other countries	3,861	12,000,000	1.66
Total	232,747	406,406,509	1.42

	Value of coal produced.	Mining population.	Coal used per head in a year, tons.
United States	$240,000,000	283,125	2.95
England	215,800,000	594,945	4.55
Germany	95,400,000	258,388	1.69
Russia	7,400,000	33,000	0.07
France	46,600,000	104,950	0.85
Austro-Hungary	24,800,000	97,200	0.62
Belgium	32,400,000	103,477	2.40
Other countries	20,000,000	60,000	....
Total	682,400,000	1,465,094	1,863

LETTERS TO THE EDITOR.

THE RIVER AND HARBOR WORKS QUESTION.

Sir: The editorial in your last issue as to government contracts for river and harbor work is excellent in its substance, and if there were no "esprit de corps" in the way I think it would work well, but for some engineers to make a tender under it would be a waste of time, I fear, if the Chief of Engineers retained power to reject any or all bids for reasons satisfactory to himself. In a recent law framed for a certain harbor, and for which a commission was provided of two military and one civil engineer, it was proposed to make an outside engineer the third man, but the employee of one of the two United States officers was actually detailed. The nature of their report on some suggestions of an outside engineer can be imagined.

I do not believe the corps would award a contract for a design which was better than their own, unless there was some strong political influence brought to bear, and this is just what we want to avoid. It is a very difficult problem, but I certainly do not approve of the system of military succession for a civil corps, as provided in the Cullom bill. Sincerely yours,

New York, Feb. 15, 1892. Delaware.

[Under the conditions which we outlined, the advertisement of a proposed work would have to be in such form that the bidder could, if he chose, offer to accomplish such and such results in certain stated times for such and such sums of money, payable in installments as the stated results were accomplished. Whether the Chief of Engineers would accept this bid or not would not rest merely on "reasons satisfactory to himself." He would be obliged to accept the lowest bid of this nature which conformed to certain advertised forms as to security, etc., unless he was prepared to assign as a reason that he considered that he could accomplish the same required result for a stated and less sum within the same time, or in less time for the same cost. He would not, indeed, be required to make himself financially responsible for this result, but he would make himself and the Corps of Engineers as a whole professionally responsible for accomplishing certain fixed results. In other words, the corps would have to promise definitely to accomplish specified results more cheaply than anyone else, in order to get power to reject the lowest bid, not per cubic yard, but for the finished work. The difference between such conditions and those which now exist is enormous. We may in some later issue outline a bill of the general nature suggested, but its substance ought to be readily imaginable from what we have already said.—Ed.]

Sir: I have made some effort to find out exactly what is wanted by my brethren of the civil branch of the profession as to participation in the control of the public works of the United States, thus far without much success.

It would appear either that they wish to have Government work placed occasionally, or possibly wholly, in their hands instead of in the hands of the United States military engineers; or that they wish to have a Public Works Department created, with the offices filled by civil engineers. The question arises, What advantage is to inure to the U. S. Government, or *pari passu* to the people at large, by any of the three plans?

To develop this, let us examine the present condition under which the public works are carried on. The United States, in order to have available a trained body of officers for military operations, has an academy where such officers are educated. Nominations for studentships in this academy are mainly in the hands of Congressmen, so that the students are drawn pretty uniformly from the whole United States, and from all the fairly educated classes of society. The usual method of selection is now by competitive examination, so that the system is freed as far as possible from favoritism, and the young men selected are intellectually at least as able as the students of other similar institutions.

At the end of a thorough course of training, both physical and mental, in which the largest part of the curriculum is similar to that of the engineering colleges of the country, a certain number of the graduates, being the most proficient in their respective classes, are assigned to the engineer corps.

We have, then, as the junior members of the U. S. engineers, a body of young men selected almost solely for merit, without regard to influence or social standing, thoroughly trained in engineering principles and with military habits of order and exactness. Is it possible by any other system to get together a body of men of the same age better fitted to conduct the engineering operations in the control of the Government? If we examine the relative capability of the corps twenty years later, when they come into comparison with the picked engineers of the civil branch, it is possible that the latter may, by virtue of the competition to which they have been subjected, show a higher standard of energy in the conduct of work, and possibly also a greater acuteness born of the wit-sharpening needed to maintain their positions. On the other hand, the struggle for existence tends to blunt slightly the moral standard, which naturally tends to be kept at a higher level by the "esprit du corps" of a body more independent of success for a livelihood.

Returning now to the introduction of civil engineers into the service, let us see what effect this would have on the quality of the work turned out.

1. Suppose that the conduct of the public works, exclusive of those of a purely military nature, were assigned in part or entirely to men selected from the civil engineers of the country. This could not be practically done by a competitive system. Failing this, have we any reason to suppose that under any system of selection practicable under our form of government a more capable body would be drawn together for the conduct of these works than that which now conducts them?

2. Suppose a civil Public Works Department created, with a regular staff recruited in its subordinate grades by competitive examination, or by any other system, from the civil engineers of the country, in what respect would the higher officials of the department differ advantageously from military engineers of the same grade? They would be drawn practically from the same classes of the population, with a little less careful selection, and their minds would be under no greater spur to alertness than the military engineers.

It does not appear, therefore, that any sensible improvement in the conduct of the U. S. Public Works could be expected from the proposed alteration.

On the other hand, economically considered, the military engineers replaced by civilians would either have to be discharged, depriving the Government of their immediate assistance in case of war, or they would be retained in partial or entire idleness, to the detriment both of the U. S. finances and of the mental activity and training of the engineer officers themselves.

It is hardly fair to compare the successes of a limited number of civilians on the public works of the country with the failures of the general body of the U. S. engineers. It is somewhat doubtful whether, if the engineering of the country at large conducted by civilians were compared with the collective work of the U. S. engineers, we should appear to advantage.

Apropos of the proposition to advertise for proposals, as suggested by you, on alternate plans and specifications with a guarantee of the work if carried out on the bidder's plans, the difficulty is, obviously, the increase of expense called for by the guarantee and by the duplicate supervision.

In a small number of cases an inspired plan might be submitted, which would accomplish the work at less expense, including the guarantee, than on the U. S. engineers' plan, but generally this would not be the case. To throw upon the U. S. engineer the decision whether the work should be done on his own specifications at less expense without guarantee, or on the bidder's plans with guarantee at greater expense, would add so much to his responsibility that it would be seemingly necessary to provide that the bidder must guarantee in all cases. This would undoubtedly add to the general expense of the public work.

Furthermore, the decision whether a guarantee is fulfilled is in many cases a very difficult one, no matter how closely the guarantee may be worded, and would add much to the difficulty of carrying on public works and to resulting litigation. Such guarantees must largely specify the fulfillment of certain conditions. The contractor in many cases would claim that a change had taken place in the circumstances, making an exact fulfillment impracticable. If such change of circumstances were ruled out by the guarantee a further increase of expense would be entailed to cover the risk.

Furthermore, such guarantee on river and harbor improvements generally involves a period of years for fulfillment, and the interest charges on the amount retained to cover guarantee would be heavily charged for by the contractor, at much greater rates than the Government could hope to get on the money held by it. Yours respectfully, W. Howard White.

New York, Feb. 16, 1892.

[Our correspondent's argument divides itself into two parts: (1) That the men are not at fault for any defects of the present system, and that any mere change of men will do no good; (2) that the particular change of method which we suggested would also do no good.

As to the first we entirely agree with him. As to the second, there is much force in some of our correspondent's arguments. It is natural that there should be two sides to any such question; but some of the arguments advanced are dubious. We notice a few.

A. The "duplicate supervision" really involves no appreciable increase in expense. There is, in any case, the same staff of engineers and working force, and the same government engineer in charge, only in the one case he controls the entire force and work,

and in the other he acts merely as inspecting engineer in behalf of the Government.

B. To say that, in a competition open to all the world there "generally would not be" any plan submitted by which responsible parties would guarantee to accomplish stated results for less money (or no more money) than the Government engineers would merely estimate was required, is begging the question. We are disposed to believe there generally would be one or more such plans submitted.

C. Of course it would be necessary to provide that "the bidder must guarantee in all cases" if he took the work on his own plans. That is the proposition. As he could only get the work by making himself financially responsible for accomplishing specified results at less cost than the Government engineers would merely commit themselves to as probable, how could the plan "undoubtedly add to the general expense of the public works"? The same is true as to changes of conditions. A bidder who undertook to get 30 ft. of water in Podunk Harbor in five years would necessarily take the risk of all changes of conditions in that harbor for that five years, except such as there had been some stipulations made about in advance.—ED.]

ST. AUGUSTINE'S ARTESIAN WATER.

SIR: The artesian pressure at St. Augustine, Fla., of which we have some very useful data supplied by the 12-in. Ponce de Leon well, is a subject that will richly repay earnest investigation. The accompanying section showing the aspect of the strata downward from the surface of the ground to the great reservoir of water may be relied upon as showing the formation throughout at least 10 sq. miles of country contiguous to the ancient city.

As will be seen, the first 76 ft. is merely sand and shell and with the exception of its weight bears no relation to the wonderful scheme under consideration. Next, however, comes 94 ft. of clay, solid, impervious, weighing about 130 lbs. per cu. ft.; then 7 to 10 ft. of hard rock, lastly the porous, fossiliferous limestone in which the water is contained under pressure with occasional dry strata of denser limestone to (we now know) a depth of 1,400 ft. The difference in the hardness of the first stratum of rock and the fossiliferous limestone underlying it may be judged from the fact that the 7 ft. of the former occupied the drillers three days while the drill easily descended through 50 ft. of the latter in 24 hours.

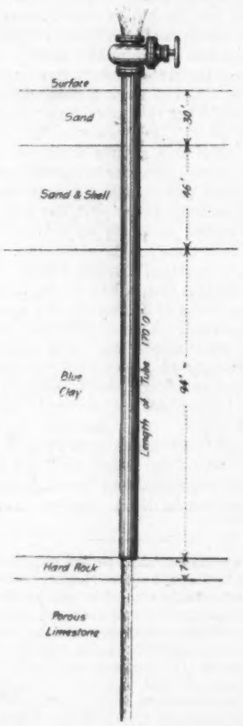
The water is largely charged with sulphurous acid gas which almost entirely escapes as soon as it is relieved from pressure upon reaching the surface; it is of course largely charged with inorganic salts, the lime constituent being in the form of sulphate and the soda in the form of muriate, the latter salt somewhat in excess of that in Saratoga water.

The pressure of water at the surface of the ground is 17 lbs. per sq. in., and at the under side of the clay stratum must be about 15,000 lbs. per sq. ft. This is the lifting power of the water. To control this power and keep it down we have 94 ft. of clay above the water, weighing 12,000 lbs. per sq. ft. If the water had to contend with nothing else this clay blanket would be tossed off by the uprising water with a force due to the unbalanced pressure of 3,000 lbs. per sq. ft., and here comes the utility of the overlying sand which supplies a balance on the side of safety of over 6,000 lbs. per sq. ft. This is what keeps the struggling giant down, and thus when we penetrate the sand and the clay and the thin diaphragm of rock the water rushes to the surface with its condensed volume of sulphurous gas, as steam from a boiler. The gas is at once liberated upon exposure and some of the mineral constituents of the water are precipitated, leaving it limpid and sparkling, without taste or smell.

These are the facts. How do they guide us to an understanding of the source of the supply and the pressure? There are two possible causes, one, gas expansion, the other, hydrostatic pressure. The writer inclines to the former, but there is nothing in the data supplied by the Ponce de Leon well to render the opposite theory untenable.

All the formation above the fossiliferous limestone is of drift origin; that is, the sand and the clay and rock, which is indurated clay. Can we conceive this deposit to have been made over a porous stone alive with a bursting flood of water under a pressure of 15,000 lbs. per sq. ft.? This seems to be altogether impossible. Then follows the conclusion that the water was not under pressure when the clay and sand were deposited, nor could that have been the case until very nearly the same conditions prevailed as exist to-day, for we have now only a sound working capital, so to speak, of sand to insure us from the flood. In this wonderful scheme every element serves a purpose, the service of the thin layer of rock underlying the clay may be found in the ocean spring (one of many along the coast of Florida) about five miles from Matanzas Inlet, concerning which we have altogether too little information, but we know that it is enormous in its dimensions, that it is sulphurous in its odor, that it is fresh and in winter warmer than the salt water surrounding it that a boat cannot remain over its vortex long enough to make careful soundings, and that while the depth of the water in its neighborhood is 60 ft. the depth at the spring is 120 ft. What is the cause of the spring? Evidently a rift in the rock diaphragm and a breaking up from some cause of the clay blanket. Here, then, is a use of this rock, the orifice through which the sulphur water escapes is defined and limited, whereas if the under part of the clay was not so protected the detrition of the clay would cause a constant enlargement of the spring to an extent awful to contemplate.

To bring Nature's grand work within the range of man's comprehension let us try to trace up the successive steps by which she has advanced; first, ages upon ages ago the minute shell fish began depositing their lime houses upon the ancient shore. To our feverish minds what a marvel it is to reflect that the whole history of the human race upon earth is a grain upon the shore compared to the continuance of this first step of advance, atom upon atom in tireless persistence the bank arose until a mountain of a thousand feet was built, then came the second step. Down from mountains that have passed from the face of the earth came the clay that overlay the shell bank, and by quiet deposit through successive ages gradually rose until the mountains were no more, then the grand movement southward of sand from the granite hills of the



Sketch Showing Geological Strata at St. Augustine, Florida.

north began to overlie the clay until a stratum of 70 odd feet had been super-added.

In the meantime the induration of the lower level of the clay had been progressing. It is very probable that the first deposit of clay was a contest with the shell fish which for a time struggled for existence, and thus the first few feet of clay was permeated with lime, and the diaphragm of rock which serves so important a use was the result.

Then, and not till then were the waters gathered upon the great plains in the center of the continent allowed to pass downward through subterranean chambers to an approach to the internal fires where, receiving heat and sulphureted hydrogen gas, they again arose and entered the great cavernous reservoir of lime rock, that had been preparing for them through almost countless ages.

Had the pressure which is now so easily controlled by the superincumbent weight existed at any of the intervening stages of preparation, the fair and fertile Peninsular State would have had no existence, and, where now bloom the orange and the palm, the magnolia and the fig, the waters of the Atlantic and the Gulf would have continued to mingle as in that ancient day ere these mighty changes were inaugurated.

To depart from a speculative view of this interesting subject and consider it from a practical and economical standpoint we shall find much of interest in the knowledge supplied by the Ponce de Leon well.

One of the objects in view held at the time this marvelous well was determined upon was that of obtaining warm water for the extensive baths then contemplated. The winter visitor to St. Augustine now finds the largest thermal sulphur baths in the world abundantly fed by the artesian well which constantly pours into them a flood of water clear as crystal from a depth 1,400 ft. below the surface. The temperature of these baths is such that the caloric given off from their 6,000 ft. of exposed surface renders the large inclosure comfortable during the most severe weather known there. The mineral constituents of the Ponce de Leon water being so large render it very dense, and the swim of 300 ft. around the great pool is not at all fatiguing to any average swimmer. One of the chief luxuries that now awaits the tourist is a plunge into these delightful waters, whose remedial virtues may be found to realize in some degree the dream of the Spanish discoverer of Florida whose name they bear.

The Ponce de Leon also supplies us with other useful information, namely, the amount of power in the artesian water available for man's use. The pressure was found to be 17 lbs. to the inch, and the flow 10 millions of gallons in 24 hours.

A turbine wheel fed by this flow maintained 120 incandescent lights at 16 c. p., proving that the well was capable of supplying a force equal to 15 HP.

Who can estimate the influence that will be wrought by this mighty, available, unvarying force, upon the industrial interests of the future. The power derived from the Connecticut River has given to Connecticut the advantage in manufacture over localities that depend upon steam power alone, in spite of the fact that the Connecticut manufacturers have to supplement their water machinery by steam engines as a recourse in times of interruption by ice, drought or flood.

Here the power in a few square miles of area is greater than the whole water power of Connecticut and the equable climate insures it without interruption throughout the year.

Concerning the maintenance of the supply we are also possessed of information upon which to form a judgment. There are now in the town of St. Augustine and its immediate vicinity in the neighborhood of fifty artesian wells varying in diameter from 2 to 12 ins., and exactly the same force exists to-day as when the first well was driven about ten years since. Another ground for believing that the supply of water is so abundant that it will prove equal to any possible draft upon it by artesian wells lies in the unvarying pressure indicated by the very sensitive gage of the electrical apparatus operated by the 12-in. well, surrounded as it is by wells on all sides being used in constantly varying quantities. Again, the increase in the diameter of the wells has been attended by more than a proportionate flow. The 4-in. wells flow 120,000 gallons a day, while the 6 in. wells flow 400,000 gallons, which is over 100,000 gallons in excess of what is due to the increased area. The Ponce de Leon 12-in. well at the same depth as the 4 and 6-in. wells flowed 3,000,000 gallons per day, which is nearly double that due to the increase of its area over the 6-in. wells, while its present output is over five times a proportionate flow compared with the 6-in well.

While the dynamo was being operated by the 12-in. well a 6-in. well in its vicinity was turned on and off suddenly to test the steadiness of the force, but the closest observation did not detect the slightest trembling of the gage. Practical electricians will know the value of this crucial test of steadiness when it is in addition stated that no governor or regulator whatever existed to control irregularities in the speed.

From these various sources of information we cannot escape from the conclusion that the water under pressure beneath St. Augustine and vicinity is practically boundless.

The ratio of increase in temperature is very nearly 1° in every 50 ft. This increase was maintained until 80° was obtained at 1,400 ft., where the well was stopped.

It is earnestly to be hoped that either by private or government means a well may be drilled as at Pesth to a depth that will reach water near to boiling point, which is indicated at less than 5,000 ft. in depth.

Government could hardly expend money in a more enlightened manner. Mr. Flagler's liberal expenditure has already added largely to our scientific knowledge of the substructure of Florida, and the gentlemen of the Geological Survey would place the world under lasting obligation were they to urge this matter upon Congress, in order that we may possess the rich store of knowledge yet to be obtained upon this subject.

When the Ponce de Leon well was drilled it was one of the largest in this country, but since that time a well 3 ft. in diameter has been sunk in California, and in Paris one 5 ft. in diameter has been successfully drilled. Such a well if sunk at St. Augustine to the depth of the present Ponce de Leon well, would, if the ratio of increase were maintained as between the 6 and the 12 in., discharge 180,000,000 gallons of water a day, yielding a force of 700 HP., and a heat in excess of the average winter temperature of 26°F. If this heat could be extracted, and there is no doubt that such a thing is within the limit of science, it would represent the heating power of 2,000 tons of coal a day—sufficient to heat the interiors of every building in the town during the cool weather, and both the power and the heat once tapped would flow out from the great reservoir for all time.

But if such a well were to be sunk to a greater depth and an equal flow were to be obtained at boiling point the energy represented by the heat therein developed would be almost beyond credence. It is impossible to fortell what uses an inexhaustible supply of mechanical power and heat could be put to; they cover nearly the whole field of human action. In France artesian water has long been used to drive machinery, and the water from the artesian wells at Grenelle is used for heating the hospitals at that place.

In Wurtemburg large manufactories are warmed in the same manner, but perhaps the most promising of all to the people of St. Augustine is that to which it is applied in the Garden of Plants, in Paris, where it is used to warm the ground and hasten the growth of vegetation.

At Erfurt, in Saxony, it is also used in this way, where a salad garden yields to its owner a profit of over $60,000 a year.

With this generous store of heat to draw upon, St. Augustine might become the winter rose garden for the country, while its production of early fruits and vegetables would prove a source of wealth that would make every foot of ground within that favored region a veritable gold mine.

William Kennish.

Wilmington, N. C., Feb. 8, 1892.

[The Ponce de Leon well at St. Augustine was described in Engineering News of April 6, 1889, and a view was given at the same time, showing the outburst of water when first tapped. We are pleased to give space to the above communication from Mr. Kennish, who was during the sinking of the well superintendent for Mr. H. M. Flagler in connection with the great hotels which he built at St. Augustine (see Eng. News, March 16, 1889). It certainly would add to our scientific knowledge if a well could be carried to a considerable depth at St. Augustine, and we hope this may yet be done. As to the possibilities of exhausting the flow of this artesian basin, and the results which might be obtained by developing power and heat from these wells, we leave our readers to form their own opinions.—Ed.]

PUBLIC WORKS IN THE UNITED STATES OF COLOMBIA.

SIR: In regard to engineering work in the United States of Colombia, there is nothing very important going on at present except it may be the iron pier that Mr. Cisneros is building at Savanilla Bay. This will be 4,000 ft. long when finished, and has now reached a length of 2,000 ft. The Cartagena Terminal Co. are working very slowly. The Santa Marta Railway is at a standstill. The Northern Ry. Co. are about to lose their concession. Work is going on steadily, but not quickly on the Cauca ity. The Antiognia Ry. is being improved, also the Savanna Ry. The Girardot Ry. is simply operated on the constructed portion, and when the dredges of the river are not engaged at snagging they average about 75,000 cu. yds. of excavation per month. Yours truly,

James T. McGauran.

Baranquilla, U. S. Col., Jan. 26, 1892.

A QUESTION OF INTERPRETATION.

SIR: We have about fifteen blocks of Cypress block paving here on concrete foundation. This was laid in 1888. Every block is in such a bad condition that it will have to be replaced with something this year, but the concrete foundation is in good condition. The question has arisen whether putting brick or stone on the concrete in place of the blocks would be "repairing" or "repaving." According to the charter of the city if this is called "repairing" it would have to be paid for by the whole city. If called "repaving" the abutting property owners would be obliged to pay for all except the intersections; what is your opinion? Yours respectfully,

W. E. Bogart, City Engineer.

Nebraska City, Feb. 13, 1892.

[A much more intimate knowledge than this letter gives of all the city charter and ordinances and conditions generally would be required before an intelligent opinion could be expressed on this knotty problem. According to our correspondent's letter this would appear to be rather a case of "repaving" than of "repairing." An argument of some strength can be made for either opinion, taking our correspondent's statements as sufficient and correct. In our issue of March 21, 1891, we gave an abstract of the practice in regard to street maintenance and assessments in ten leading American cities, and perhaps our correspondent will get some light on his problem by examining that article.—Ed.]

NOTES AND QUERIES.

H. L. B., Cincinnati, O., asks the following question: How deep will a shot from a modern heavy gun and from a rapid fire Hotchkiss gun penetrate below the surface of the water at close range? Would a shot from one of the rapid fire guns of the Hotchkiss type mounted in the military top of a war ship be apt to injure a torpedo 6 ft. under water close to the ship's side?

[As the modern heavy gun cannot be depressed sufficiently to affect a torpedo at close range, and as water is practically incompressible at the high velocity of modern projectiles, the heavy gun can be left out of the question, as any shot that could otherwise effect the torpedo at long range would glance from the water surface. As to the Hotchkiss rapid fire at close range, we cannot exactly state effect. But the new 18-in. Whitehead torpedo can travel for half a mile at the rate of about 30 knots, or about 3,000 ft. per minute. A shot from the high angle of a military top might strike a target moving at this rate, and it might not. But the incompressibility of water comes into play here too, and we doubt if a 3-pounder would have any material effect upon a target 6 ft. under water.—Ed. Eng. News.]

A subscriber asks: "Why is camber put in a truss of any kind? Is it merely 'a matter of looks,' so that when the bridge is fully loaded the chords shall not sag below the horizontal, or is there some other important reason? Do you think camber has anything to do with the strength of a bridge?" In answer we would say that as originally applied to wooden bridges camber was intended to compensate for the almost inevitable sagging due to imperfect jointing and the shrinkage of timber, and was usually about 6 ins. in 100 ft. Camber as now applied to iron and steel structures is practically "a matter of looks," and is so calculated as to bring the truss to a horizontal line under the maximum load. It now rarely exceeds 1 in. in 100 ft. To the eye a perfectly horizontal line would look as if it sagged, and taste demands a slight camber upward. Camber has really nothing to do with the strength of the bridge.

Mr. Jas. T. McGauran, Baranquilla, U. S. Colombia, desires information as to automatic sluice gates.

In answer to query of H. K. O. in our last issue, of Feb. 6, concerning borax, we would refer him to a report published by Mr. Henry G. Hawks, of San Francisco, as Chief of the Mining Bureau of California. We find on inquiry that literature on the subject of borax is exceedingly meagre.

S. C. writes: In the article on "The Engines of the San Francisco," in your issue of Feb. 6, the term adjustable pitch of the propellers is used. Will you please explain the term in some coming issue? The term means just what it says; the pitch of the blades is adjustable within certain limits, i. e., the blades are not rigidly fixed to the hub. We have an illustrated description of such a propeller in preparation.

A. L. J. answers the query of M. Am. Soc. C. E. (Feb. 23, 1892), as to pavement measurements as follows: It has always been the practice in Richmond, Va., in the paving of streets and the repaving in the construction of street railways to deduct the width of the rails. I have measured a great many miles of paving and repaving of streets and railways and invariably carried out this rule in settlement with the contractors.

Mr. L. W. Matthewson, on the same question, cites the usual provision made in the specifications for city work in Cincinnati: "No extra or 'customary' measurements of any kind will be allowed in measuring the work under these specifications; but the actual length, area, solid contents or number only shall be considered." The area of surface occupied by street railroad tracks is always deducted.

INCREASE IN THE LONDON WATER SUPPLY.

In the last "Nineteenth Century" Sir John Lubbock has an interesting paper on the urgent necessity of providing for the future water supply of the metropolis of London. With a good judgment, rare in papers of this character, the author commences his statement by the following very convincing array of figures.

Data.	1870.	1891
Population supplied by the 8 London Water Companies	3,350,000	5,700,000
Daily average consumption, in galls.	104,000,000	184,000,000
Minimum daily flow of the Thames	283,000,000 gallons.	
Maximum daily amount that can be legally taken	150,000,000	"
Daily amount that the Royal Commission considered as the maximum that ought to be taken from the Thames	110,000,000	"
Average daily amount taken from the Thames for 1891 (Jan. to Sept., 1891)	96,926,000	"
Amount taken daily from the Thames for July, 1891	104,400,000	"
Present daily average supply for London use:		
From the Thames,	96,926,000 gallons.	
From the Lea	50,644,000 "	
Springs and wells, Lea Valley	13,580,000 "	
From Kentish wells	13,700,000 "	
Total daily supply	183,850,000	"

From this exhibit Sir John properly argues that the question of water supply is one of the most important that Londoners have to face. It is true that the Royal Commission of 1869 made a careful inquiry and came to the conclusion that the Thames and the Lea, supplemented by the water obtained from the Chalk and the Lower Green Sand, would furnish a supply sufficient for any probable increase of the metropolitan population. But they figured 200,000,000 gallons daily as the highest demand to be reasonably looked for, and thought a population of 4,500,000 or 5,000,000 "a very remote" contingency. Even now their remote estimate of population is surpassed and rapidly increasing and the "maximum" consumption is nearly reached.

Sir John Lubbock then shows by figures that the maximum quantity of water that can be safely taken from the Thames is reached, and the same may be said of the River Lea, if not exceeded in the latter case. The Royal Commission itself did not believe that the supply from the chalk was unlimited in its quantity, and the commission thought that as the reservoirs in the chalk fed the Rivers Lea and Thames above Hampton, any water gained from the chalk must diminish the flow in these streams. This is the opinion of other high authority. Mr. Binnie, Chief Engineer to the London Council, who has made a careful study of the question, reports that he knows of no sites in the Thames area suitable for storing water for the supply of the metropolis. Mr. Whitaker, F. R. S., and Prof. A. H. Green, F. R. S., made a special report on the geology of London, and in this they point out the fact that even were it found practicable to construct storage reservoirs, "the water impounded in them would be largely water that has flowed off highly cultivated and much manured land." The area required would be large, and the land is valuable. These gentlemen also conclude that there is "but little prospect of constructing reservoirs for the impounding of water in any part of the Thames valley."

The inevitable conclusion is that London must go abroad for its water and Sir John thinks no time should be lost in taking the preliminary steps. This brings up the question of the proposal of the London County Council to buy up the London water companies and place the whole water supply under municipal management. The majority of the Council favor this purchase, but is opposed to purchase by arbitration, as tending to make London pay more than the works are really worth. The water companies, on the other hand, have so exalted an idea of values that purchase by agreement seems absolutely impossible.

Sir John Lubbock suggests that the increased payment to the water companies under the present quinquennial revaluation of London property be abandoned, that the London County Council provide an additional water supply, and that an arrangement be made whereby future profits should be shared equitably between the companies and the people of London, as is now done with the gas companies. The author believes that while this proposal would be difficult to carry out it is possible, and the provisions of the special acts under which the companies exist, compelling them "to bring pure and wholesome water to every part of their district," will assist in this end. No future source of supply is suggested in the paper, but London is warned that other large cities are rapidly appropriating the available areas.

A FOUR-SCREW HOPPER DREDGE.

In a paper read before the Institution of Civil Engineers, Mr. Wm. George Walker describes a hopper dredge used by the corporation of Bristol, and gives results of its working. This dredge has four screws, two forward as well as two aft, and was built by Simons & Co. at Renfrew for $150,000 in 1885.

The vessel is built of steel, with a ladder-well aft and chain of buckets, and it has a hopper capacity of 1,000 tons of material, which it can dredge in one hour. It can dredge to a depth of 36 ft. below water surface when the vessel is light and the ladder set at an angle of 45°, and can also dredge this channel in advance of the boat.

There are two sets of triple-expansion engines of the ordinary marine type, developing 1,300 HP. at a piston speed of 500 ft. per minute, and a boiler pressure of 140 lbs. per sq. in. The speed, fully loaded, is 9 knots per hour.

Within five years this dredger removed and deposited in Bristol Channel 1,500,000 tons of spoil, including in this mud, sand, sandstone rock, concrete walls and piles. The cost of dredging for this period amounted to about 10 cts. per ton, including wages

coal, grease and sundries, the conveyance of the dredged material 10 miles from the Bristol docks, and the interest on the first cost of the plant. Three new sets of bucket-pins were fitted and these were the only repairs of consequence. The working force includes 20 men, viz.: a captain, a mate, 3 engineers, 4 cranemen, 4 firemen and 7 sailors. The double sets of screws are used because the river Avon is not wide enough for the turn to be made. The details of the hull, dredging machinery and engines and boilers are given in the paper.

VAUCLAIN FOUR-CYLINDER COMPOUND LOCOMOTIVES.

In our issue of May 3, 1890, we described and illustrated the first four-cylinder compound engine of the Vauclain system, which was an eight-wheel passenger engine built by the Baldwin Locomotive Works, of Philadelphia, Pa., for the Baltimore & Ohio R. R. In later issues we have noted from time to time the progress made in the introduction of this system of compounding locomotives, and have illustrated and described some of the engines. The system is the invention of Mr. S. M. Vauclain, Superintendent of the Baldwin Locomotive Works, and has been awarded a medal by the Franklin Institute. Up to the present time 103 engines of this kind have been built for American and foreign railways, including engines of various kinds, for all classes of service, and 51 engines are now under contract. The following tables show the numbers built for individual roads in this country and abroad, and also the totals for each class of service. Of the 52 engines for abroad, 49 are for various railways in Brazil, and the separate orders received for some of these roads, particularly from the Central of Brazil Railway (formerly the Dom Pedro Segundo Railway) tend to show that their performance has been satisfactory. In this country the range of service is quite extensive, including ordinary passenger and freight engines, and ranging from the fast express of the Philadelphia & Reading R. R. (Eng. News, Nov. 21, 1891) to the pusher engines for the New York, Lake Erie & Western R. R., mentioned below.

Number of Vauclain Four-Cylinder Compound Locomotives Built and Under Construction.

	Engines.			
	Delivered.		Under const'n.	
	No.	Service.	No.	Service.
American Mast. Mech. Assoc.*	1	P. & F.	1	Freight.
Baltimore & Ohio	1	Pass.	..	....
Buffalo, Roch. & Pittsburg	2	Freight.	..	....
Central of New Jersey	2	"	..	....
" " "	1	Pass.	..	....
Chicago & So. Side Rap. Tran.	..	....	20	Pass. tank
Chicago, Mil. & St. Paul	1	Pass.	2	....
Cleveland, Akron & Columbus	..	....	2	P. & F.
East Tenn., Va. & Georgia	..	....	1	Pass.
Lehigh & Lackawanna	1	Pass.	..	....
" "	1	Freight.	..	....
Lehigh Coal & Navigation	..	....	2	Freight.
Lehigh Valley	2	Freight.	..	....
Long Island	..	....	5	Pass.
Longdale Iron Co.	..	....	1	Freight.
Los Angeles Terminal	1	Freight.	..	....
N. Y., Lake Erie & Western	1	Pass.	..	....
" "	5	Freight.	..	....
Norfolk & Western	..	....	5	Freight.
Northern Pacific	1	Freight.	..	....
Pennsylvania	5	"	..	....
Pennsyl. & Northwestern	6	"	4	Freight.
Philadelphia & Reading	20	"	5	Pass.
"	1	Pass.	..	....
Texas Central	2	Freight.	..	....
Western Maryland	1	"	..	....
Western N. Y. & Pennsyl.	1	"	..	....
Wilmington (N. C.) St. Ry. Co.†	..	....	1	Switch.
Total for United States, 102.	55	....	47	....
Brazil.				
Bahia Extension	1	Freight.	..	....
" "	4	"	..	....
Central of Brazil (formerly Dom Pedro II.)	3	Pass.	..	....
Central of Brazil	3	"	..	....
" "	3	"	..	....
" "	3	Freight.	..	....
" "	3	"	..	....
" "	2	"	..	....
Leopoldina	1	Pass.	..	....
Minas Western	1	"	..	....
" "	1	Freight.	..	....
Mogyana	1	Pass.	..	....
Paulista	3	"	4	Pass.
"	3	Freight.	..	....
"	5	"	..	....
Pernambuco	3	"	..	....
"	4	Pass.	..	....
Ramal Dumont	1	Freight.	..	....
Total for Brazil	49, 45	....	4	....
Mexico.				
Mexican National	1	Pass.	..	....
Australia.				
New South Wales Govt.	2	Freight.	..	....
Total of Mex. and Aust., 3	3	....	0	....
Grand total	54, 103	....	51	....

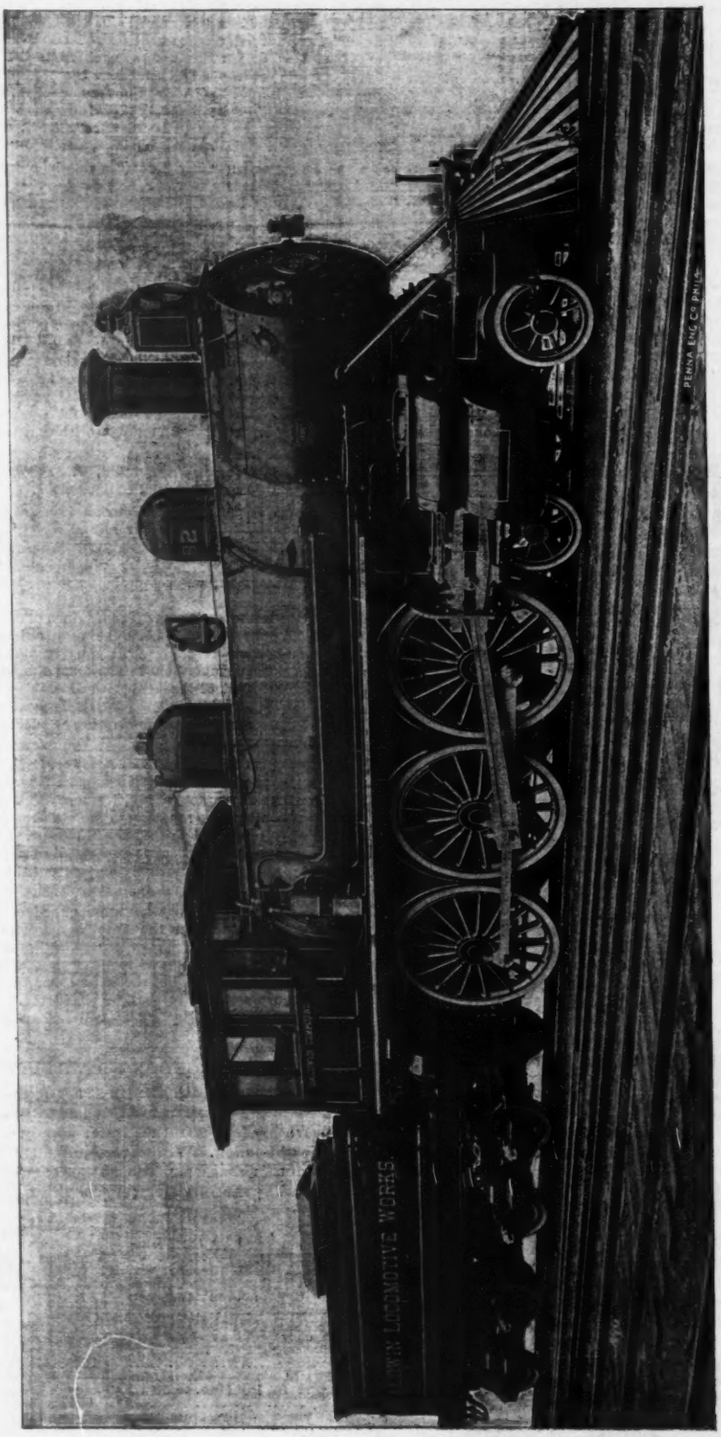
* For test purposes.
† Noiseless switching engine.

Summary of Vauclain Four-Cylinder Compound Locomotives.

Engines delivered:	United States.	Foreign.	Total.
Passenger	6	20	26
Passenger and freight	1	..	1
Freight	48	28	76
Total delivered	55	48	103
Engines under construction:			
Passenger	31	4	35
Passenger and freight	2	..	2
Freight	13	..	13
Switch	1	..	1
Total under construction	47	4	51
Total delivered (as above)	55	48	103
Grand total	102	52	154

Since the construction of the first engine above referred to, the drawings of the compounding, details of which were given in our issue of May 3, 1890, only slight modifications have been made in these details, and the operation has proved very satisfactory. The distribution of steam is effected by a hollow piston valve. The accompanying cuts show the position of valve and the course of the steam with the piston at the back end of stroke (Fig. 1), at mid stroke (Fig. 2), and at the forward end of stroke (Fig. 3). An average of the tests made shows an economy of from 20% to 35%, according to the variety of service, in consumption of fuel, and about 20% in consumption of water, over that of simple engines in comparable service.

The builders state that it is difficult, and probably inexpedient, to fix an average rate of economy, inasmuch as it varies with almost every variety of service, and also varies with the plan of locomotive. In fast passenger service, burning bituminous coal,



TEN-WHEEL LOCOMOTIVE; VAUCLAIN FOUR-CYLINDER COMPOUND SYSTEM.

Baldwin Locomotive Works, Philadelphia, Pa., Builders.

they would consider 20% a fair degree of economy, while in heavy slow freight service, where there is a continuous haul and little descending grade, they say that the compounds have repeatedly shown as high as 50% economy. The percentage of economy varies also with the amount of running down hill with steam shut off which the engine has to perform, and therefore the economy from the same engine would vary on different roads. This is apparent upon a moment's consideration, as the compound will, of course, burn as much coal running down hill as a single expansion engine. The type of engine affects the economy, particularly the dimensions of firebox. An excessively large grate would permit a continuous combustion, irrespective of the amount of work done. In this case, however, the compound system would have the great advantage of the soft exhaust, permitting the use of inferior grades of coal which would be drawn through the tubes by the sharp exhaust of a single expansion engine. For this reason the builders prefer to fix wide limits for the average percentage of economy, and suggest from 20 to 35% as being a conservative claim. Economy of water consumption is more constant, except where the comparison is destroyed by the engine standing round blowing off, or from any of the many other causes which make such comparisons difficult. So far as their observations go the total economy of compounds under favorable circumstances is from 35 to 40%, of which about 20% is in the reduction of water rate; and from 15 to 20%

Wheelbase, driv'g	18 ft. 10 ins.	12 ft. 6 ins.	5 ft. 0 in.
" truck	.....	6 " 9 "	4 " 8 "
" total	27 ft. 3 ins.	24 " 6 "	16 " 4 "
Weight on driving wheels	170,000 lbs.	98,650 lbs.	40,000 lbs.
Weight on truck	23,000 "	34,650 "	16,000 "
Weight, total	193,000 "	133,300 "	56,000 "
Tank capacity	4,500 galls.	3,000 galls.	750 galls.
Bunker "	10 tons.	6 tons.	2 tons.
Brakes	Westing. autom.	Westing. autom. and American.	Eames vac.

A through railway connection between the English railway systems north and south of the Thames will probably be effected if the new line to London from the north is built by the Manchester, Sheffield & Lincolnshire Railway. This will be done by a junction with the Metropolitan Railway or the North London Railway to form the connecting link between the Manchester, Sheffield & Lincolnshire Railway and the Southeastern Railway.

Work on the new Baltic Canal [Eng. News, Aug. 1, 1891, etc.] is at present only carried on with a few workmen on account of the inclemency of the weather. Work on masonry has been discontinued almost entirely. The piers for the great bridge of 513 ft. span are now about 6¼ ft. above the concrete foundation; their interior spaces, as far as they are not to be occupied by machinery, are filled with tamped concrete. A small section of the canal has been finished and is in use.

An artesian well at Szarvas, Hungary, finished a short time ago, is 951 ft. deep, the water rising to a height of nearly 17 ft. above its surface, and flowing 92,875 gallons in 24 hours. The expense of driving the well was about $12,000.

A triple expansion locomotive of decidedly original design has been built, and is being tired by Mr. John Rickie, Locomotive Superintendent of the Northwestern Ry., at Quetta, India. According to the "Schweizerische Bauzeitung" this engine has three horizontal cylinders, the horizontal axes of which are in the same plane. The outside high-pressure cylinder at the left receives steam direct from the dome and exhausts into the outside intermediate cylinder at the right. These two are double acting; the low-pressure cylinder is between frames, and is single acting, taking steam from the intermediate cylinder.

The boiler of this engine is composed of three cylindrical barrels in order to make room for the valve-gear of the low-pressure cylinder, the two lower barrels being far enough apart to allow the gear to work between them. The dome is provided with a valve, operated from the cab, by which live steam can be admitted into both outside cylinders, so as to secure power for starting easily. We shall shortly give a more complete description of this interesting novelty in locomotive construction.

A wooden fly-wheel, 30 ft. in diameter, has been erected at the Amoskeag Mills, in Manchester, N. H., to replace the one destroyed in the accident of Oct. 16 last. This wheel has a wooden rim made of ash and 9 ft. wide carried on two sets of cast iron arms, 24 in all. In the test it was run up to 76 revolutions per minute. Power is taken from this wheel by means of two 51-in. belts. The wheel was all iron, and weighed 116,000 lbs.; the new wheel weighs 100,000 lbs.

A new aluminum works is promised. It is to be located at Anderson, Ind., and the Bucyrus Construction Co., and the Bucyrus Dredging Co., are mentioned among the incorporators. The process to be used is vaguely described as that of "Dr. Walker, of Denver."

Unfreezable dynamite has been brought out by the Unfreezable Dynamite Co., of London, England, with a view of preventing the numerous accidents caused by carelessness of the men in thawing out the cartridges by baking, boiling or otherwise heating them. The unfreezable mixture was invented by Edward Liebert, of Berlin, Germany, and its main feature is the addition of a small percentage of isoamylic nitrate to the nitro-glycerine or to the dynamite itself. The dynamite is thus rendered uncongealable and somewhat less sensitive to concussion, while its explosive power is slightly increased. Dynamite is said to freeze at about 40° F., while isoamyl requires a temperature of more than 35° below zero to freeze it.

Iron and steel industries in the New England States form the subject of Census Bulletin No. 156. The substance may be set forth in the following tabulation:

	1870.	1880.	1890.
No. of establishments	48	61	35
Invested capital	$5,909,000	$11,560,408	$13,415,450
Hands employed	3,815	8,654	6,645
Wages paid	$2,168,719	$3,357,911	$3,224,318
Material consumed, cost	$7,338,150	$9,518,570	$9,286,050
Value of product	$10,824,603	$14,558,627	$15,105,441

It should be remembered that the values for 1870 were expressed in a currency which was at a great discount in gold, and for this reason they should be reduced about one-fifth for purposes of later comparison. It will be noticed that while the number of establishments and the hands employed in 1890 decreased, as compared with 1880, the wages paid and the value of materials consumed remained about the same, and the capital invested and product increased.

"No building shall be hereafter erected in the City of Chicago of a height exceeding 150 ft.," is the commencement of an ordinance just passed by the City Council of Chicago. The ordinance further declares that buildings on any street not more than 80 ft. wide shall not exceed 125 ft. in height, and on streets 40 ft. wide not more than 100 ft. It is provided that if a building is set back from the street line proper, so that the space in front meets the requirements of street width, then the height may be increased

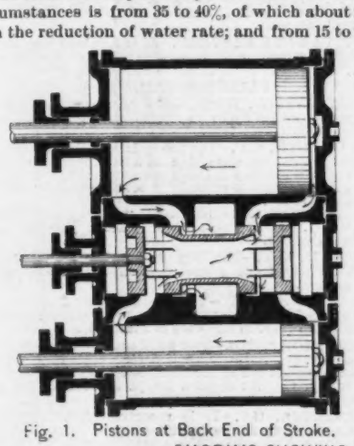


Fig. 1. Pistons at Back End of Stroke.

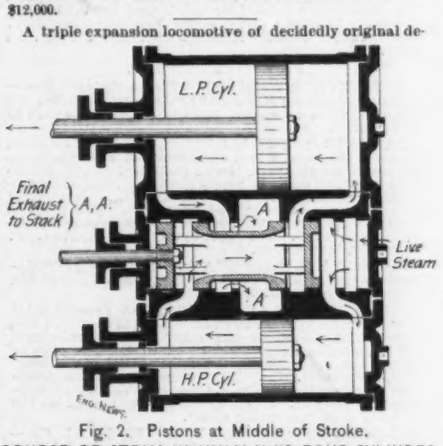


Fig. 2. Pistons at Middle of Stroke.

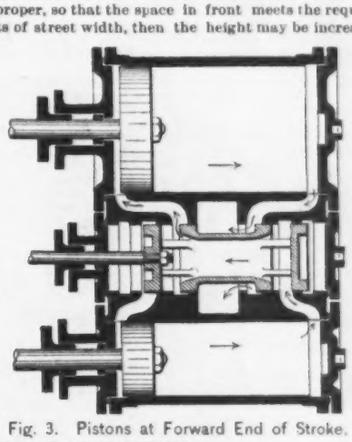


Fig. 3. Pistons at Forward End of Stroke.

DIAGRAMS SHOWING THE COURSE OF STEAM IN VAUCLAIN'S FOUR-CYLINDER COMPOUND LOCOMOTIVES.

additional, in the better action of the boiler, in consequence of the soft exhaust.

Among the engines recently built are four ponderous decapod engines, with ten driving wheels and a two-wheel leading truck, for service as pushers on the Susquehanna Division of the New York, Lake Erie & Western R. R., and a ten-wheel passenger engine for heavy trains, built for the purpose of tests to be made by a committee of the American Master Mechanics' Association. This engine is now undergoing tests on the Pennsylvania R. R. lines west of Pittsburg, and a view of it is given herewith. An order has also been given for 20 Forney tank engines for the Chicago & South Side Elevated Railway, which road was described in our issue of Jan. 16, 1892. The fireboxes of the ten-wheel and tank engines have radial stays. The following are the leading dimensions and particulars of these three classes of engines:

	Decapod.	Ten-wheel.	Tank.
Cylinders, c. p.	16 × 28 ins.	14 × 24 ins.	9 × 16 ins.
" l. p.	27 × 28 "	24 × 24 "	15 × 16 "
Diam. of driving wheels	4 ft. 2 ins.	6 ft. 0 in.	3 ft. 6 ins.
Diam. of truck wheels	2 " 6 "	2 " 9¼ "	2 " 2 "
Diam. of boiler	6 " 4 "	5 " 2 "	4 " 0 "
Form of boiler	With comb. chamber.	Straight.	Straight.
Size of firebox	133⅞/16 × 9⅝ ins.	120¼ × 34 ins.	66⅛ × 43¼ ins.
Tubes, material	Iron.	Iron.	Iron.
" number	354	270	167
" diam out.	2 ins.	2 ins.	1¾ ins.
" length	12 ft. ¼ in.	14 ft. 0 in.	5 ft. 6 ins.
Boiler pressure	200 lbs.	180 lbs.	200 lbs.
Grate area	90 sq. ft.	28.4 sq. ft.	20 sq. ft.
Heating surface, tubes	2,208.8 sq. ft.	1,965.6 sq. ft.	484.5 sq. ft.
Heating surface, firebox	182.5 "	169.7 "	70.0 "
Heating surface, combustion chamber	51.8 "	.....	.....
Heating surface, total	2,443.1 "	2,135.3 sq. ft.	554.5 sq. ft.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago.—Existing Roads.

PITTSBURG, OHIO VALLEY & CINCINNATI.—Tracklaying has been completed from Bellaire, O., to with one mile of Powhattan, O., and work is rapidly progressing. This line is 15 miles long, and seven miles were built last year.

PHILADELPHIA & READING.—This company will, it is stated, make extensive additions to its repair shops at Reading, Pa.

PENNSYLVANIA.—Grading is in progress upon four miles of the extension of the Chestnut Hill Branch to Ft. Washington, Pa., on the Trenton Cut-off. The line will be double track.—A bill has been introduced into the Maryland Legislature authorizing the Delaware & Chesapeake R. R. Co. to build a branch from Greensboro to Tangier Sound.—Surveys have just been completed for an extension of the Green Springs Branch of the Northern Central R. R., to Westminster, Md., about 21 miles. Local papers state that it is the intention of this company to continue the line to a connection with the Frederick & Pennsylvania Line R. R. at Taneytown, Md., about 10 miles further.

WEST VIRGINIA CENTRAL & PITTSBURG.—Maps have been completed showing the route of the proposed Baltimore & Cumberland R. R. through Middletown Valley as recommended by Civil Engineer Coryell, who recently made a preliminary survey from Hagerstown to Baltimore. The route after leaving Hagerstown and Boonsboro crosses the South Mountain via either Crampton's or Turner's Gap, strikes Middletown, crossing Catoctin Mountain at Lighter's Gap, and strikes Frederick. From Frederick to Baltimore the proposed route touches Uniontown, Taylorsville, Harrisonville, Randallstown and Wetheredville. The section of the line from Cumberland, Md., to Hagerstown was surveyed some time ago.

SANDUSKY & COLUMBUS SHORT LINE.—This company has given a mortgage for $3,000,000 to the Metropolitan Trust Co., of New York City, the proceeds to be used in building and equipping its line. A correspondent sends us the following corrections to the note copied from the "Cleveland Leader" in our issue of Feb. 6. The total length of the line from Columbus, O., to the company's docks in Sandusky, O., is 108 miles. The surveys have been practically completed and the right of way is being secured. The maximum grade north is 25 ft. per

up to the maximum of 150 ft. The law does not apply to buildings now under actual contract, nor does it apply to spires, towers, domes or cupolas whose area shall not exceed 15% of the ground area of the proposed building.

mile, and south, is 39 ft. per mile. F. J. Aid, Marion, O., Chief Engineer.

ODESSA & MIDDLETOWN.—Work has been abandoned on this 4¼-mile railway from Odessa to Middletown, Del., according to press dispatches.

NEW YORK CENTRAL & HUDSON RIVER.—A press dispatch from Buffalo, N. Y., gives the following information about the proposed repair shops at that place, noted in our last issue: "There is no longer any doubt regarding the intention of the New York Central people to build extensive car shops in this city. The exact location has not yet been determined upon, although it is understood that the company has purchased considerable land for this purpose. It is understood that the company is disposed to expend about $500,000 in the construction of these shops, which will be used both for repairing and manufacturing."

LONG ISLAND.—Surveys are in progress for the proposed New York Bay Extension R. R., noted last week. It is stated that this line will be built this year, and that it will cost about $600,000. It is rumored that the freight terminus of the new route to Boston is to be changed from Oyster Bay to Whitestone. The company has recently filed in the Queens Co. Clerk's office, at Jamaica, L. I., a map for terminal improvements at Whitestone, which provide for the construction of 40 tracks for freight purposes, terminating on the shore of Long Island Sound, to facilitate loading and unloading from floats.

Projects and Surveys.

WESTERN INDIANA.—The directors of this company, whose incorporation was noted last week, are: W. H. Gastlin, W. H. B. Menzies, E. E. Towle, Peter Crumpacket, C. M. Towle, A. G. Towle, J. W. Dake, H. Lundt and A. W. Warren. The proposed road is to run from Hammond to La Porte, Ind., 50 miles.

MANISTIQUE & NORTHEASTERN.—Chief Engineer W. H. Beardsley is reported as saying that this proposed road would certainly be built during the coming summer. It is projected to run from Manistique to Ishpeming, Mich., 91 miles. About 30 miles of the right of way have been secured and contracts for the cross-ties are now being let.

SELINSGROVE & MIFFLINBURG.—An effort is being made by the people along the route to secure the construction of a railway from Selinsgrove to Mifflinsburg, Pa., 15 miles.

SOUTHERN CENTRAL.—According to the local papers there is some prospect that work will be commenced on this road soon. It is projected to run from Sunbury to a connection with the Philadelphia & Reading R. R., near Dauphin, Pa., 45 miles.

ATLANTIC TERMINAL.—Chartered in New Jersey to build a railway from a point on Oyster Island, in New York Bay, to Walker Ave., in Jersey City, where connection will be made with the West Side Connecting road. The road will be 3 miles long. Among the incorporators are: Edward S. Man, Bayonne, N. J.; R. W. Woodward, Elizabeth, N. J., and Geo. D. Murray, Montclair, N. J.

Southern—Existing Roads.

BIRMINGHAM, SHIFFIELD & TENNESSEE RIVER.—There is some prospect that this company will build its proposed extension from South Parrish to Birmingham, Ala., about 40 miles, during the coming summer.

OWENSBORO, FALLS OF ROUGH & GREEN RIVER.—It is stated that locating surveys will soon be begun for the proposed extension from Fordsville to Caneyville, Ky., about 30 miles.

LOUISVILLE & NASHVILLE.—This company is preparing plans for a large passenger station and other terminal improvements at Montgomery, Ala.

OHIO VALLEY.—The contract for the second section of the 11-mile branch from Gracey to Hopkinsville, Ky., has been let to W. A. Shippy, of Memphis, Tenn., who has begun work. Work is also in progress upon the 5-mile section for which Hugh Morgan has the contract. It is expected to have the grading completed by April 15 and the line in operation early in June.

TENNESSEE MIDLAND.—The report is in circulation that the 25 miles of this road from Memphis to Jackson, Tenn., will be purchased by the Illinois Central System, and that another company will be formed which will purchase the 50 miles from Jackson to Perryville, Tenn., and build the proposed extension to Nashville.

MONTGOMERY, TUSCALOOSA & MEMPHIS.—It is stated that work will be resumed soon upon this line from Montgomery to Tuscaloosa, Ala., 107 miles. A large part of the grading has been completed, and a considerable amount of the track material is on hand.

PENNSYLVANIA.—It is stated that the right of way has been secured for a branch of the Pittsburg, Cincinnati & St. Louis R. R. from New Cumberland, W. Va., to East Liverpool, O., and that construction will be begun as soon as the weather permits.

ATLANTIC COAST LINE.—Tracklaying has been completed on the Wilson & Fayetteville R. R. from Fayetteville to Rowland, N. C., 42.6 miles. Thirty miles of the line were completed in 1891 and the remainder since.

ST. LOUIS & BIRMINGHAM.—Ch. Engr. L. S. Proctor, of Clifton, Tenn., writes us that this company is getting in good shape to construct its line, which runs from Clifton, Tenn., to Florence, Ala., about 65 miles. The location has been completed and a very favorable line secured. The maximum grade is 66 ft. per mile and the maximum curve is 6°. The principal business will be in lumber and iron ore. Work is in progress upon a short section of the line near Clifton, Tenn. C. R. Johnson, of Clifton, Tenn., is general manager.

Projects and Surveys.

ALABAMA & MISSISSIPPI.—This company has been incorporated in Alabama to build a railway from Hickinsville, Ala., to Columbus, Miss.

PENNSYLVANIA & ALABAMA COAL CO.—This company has been chartered in Alabama to build the proposed railway from Tuscaloosa, Ala., to the Maxwell coal seam on the Warrior River. The incorporators are F. M. Abbott, of West Point, Miss., and C. W. Stone, of Warren, Pa.

MOBILE, TUSCALOOSA & FLORENCE.—This company has been organized to build the proposed railway from Mobile to Florence, Ala., 341 miles. J. A. Milner, Birmingham, Ala., Ch. Engr.

TENNESSEE CENTRAL.—It is stated that a party of capitalists has offered to build the 12-mile section of this road from Trenton to Milan, Tenn., on condition that these towns vote $50,000 and $10,000 of bonds respectively. D. M. Youmans, of New York City, is interested.

PICKENS.—This company has been organized in North Carolina to build a railway from Pickens to Easley, N. C. J. E. Boggs, T. D. Harris and others, of Pickens, N. C., are interested.

VIRGINIA.—Valentine Heckler, A. G. Babcock, Walter Sydnor, Thomas N. Carter, Lloyd T. Smith and others are the incorporators of the Richmond & Rappahannock Valley R. R. Co., noted in our last issue as applying to the legislature for a charter. The company is authorized to build a railway commencing at or near Richmond to deep water on the Rappahannock River or Chesapeake Bay. It may acquire by lease, consolidation or merger the rights, privileges and franchises of the Richmond & Seven Pines R. R. The authorized capital stock is $3,000,000.——The East Virginia & Tidewater R. R. Co. has applied to the legislature for a charter to build a railway from some point in the counties of Hanover or Spottsylvania to some point on or near the Chesapeake Bay in the counties of Middlesex, Gloucester or Mathews.——Bills incorporating the Blue Ridge Springs & Fincastle R. R. Co. and the Rockingham & West Virginia Ry. Mining & Mfg. Co. have been introduced into the state legislature.

Northwest.—Existing Roads.

CHICAGO, FT. MADISON & DES MOINES.—Surveys have been commenced for the proposed extension from Libertyville to Ottumwa, Ia.

CHICAGO, BURLINGTON & QUINCY.—This company has issued a circular to its stockholders offering them the right to take the proposed new issue of bonds at par up to 10% of their holdings. The circular states that the proceeds will be used to pay for about $4,000,000 new equipment, additional tracks and terminal facilities, new shops in Nebraska and other additions and improvements.

NORTHERN PACIFIC.—A press dispatch states that the contract has been let for an extension of the Jamestown & Northern R. R. from Leeds to Dunseith, N. Dak.

CANADIAN PACIFIC.—A correspondent sends us the following corrected list of new track laid by this company in Manitoba and the Northwest Territory in 1891: Souris Branch—Hartney toward the Souris coal fields, 85 miles; 43 miles in Manitoba and 42 in the Northwest Territory. Southwestern Branch—Methven to Nesbitt, Man., 5.6 miles.

Projects and Surveys.

MARINETTE & WESTERN.—The preliminary survey of this railway from Marinette to Abbottsford, Wis., 160 miles, has been completed and the reports submitted to the directors.

MANKATO & NORTHEASTERN.—F. D. Woodbury, Ch. Eng., Mankato, Minn., writes us that the location of this road from Mankato, Minn., northeast to the Mississippi River, 75 miles, is nearly completed, and that contracts for grading will be let about May 15. It is intended to have the road completed this year. The route is through a thickly settled country. There will be considerable rock work. The right of way is all obtained. P. H. Carney, is President.

CHICAGO, LAKE GENEVA & NORTHWESTERN.—Chartered in Illinois to build a railway from Chicago to a point on the Wisconsin line.

CHIPPEWA FALLS & SUPERIOR.—A press dispatch says: Advices from St. Paul, Minn., are to the effect that Frederick Weyerhauser and other leading lumbermen held a meeting there and agreed to build a railway through the pine woods from Chippewa Falls, via Hayward, to Superior, Wis. The lumbermen in the agreement represent the St. Croix, Chippewa Valley and Mississippi companies. It is proposed to begin work on the new road as soon as spring opens.

ILLINOIS AND IOWA RY. & TERMINAL CO.—Chartered in Iowa to build a double track railway bridge across the Mississippi River, transfer yards at Davenport, Ia., and Moline, Ill., and an independent road to Clinton, Ia.

Southwest.—Existing Roads.

KANSAS CITY, WATKINS & GULF.—Tracklaying on this line has been completed to Spring Creek, La., 22 miles south of Alexandria, La.

SOUTHERN PACIFIC.—The engineers of this company have begun the surveys for the New Iberia & Vermillion R. R. projected to run from New Iberia to Abbeville, La.

MISSOURI, KANSAS & TEXAS.—The Missouri, Kansas & Eastern Ry. Co. has been chartered in Missouri to build a railway from Franklin, Mo., on the Missouri River, opposite Boonville, Mo., to St. Louis, Mo. The capital stock is $4,500,000 and the incorporators are all St. Louis men. This incorporation is thought to have been made in the interest of the Missouri, Kansas & Texas Ry. Co. and the new line to be intended for the proposed independent line to St. Louis, which was noted in our last issue.

MISSOURI PACIFIC.—It is stated that this company has ordered the commencement of work on the proposed line from Boonville to Jefferson City, Mo., about 30 miles.

Projects and Surveys.

VELASCO NORTHERN.—Chartered in Texas to build a railway from a point on the Brazos River, opposite Velasco, Tex., to Richmond, Tex., 60 miles. Among the incorporators are Newton B. Childs, of Kansas City, Mo., and H. B. Lincoln, of Denison.

GAINESVILLE, SOUTH McALISTER & ST. LOUIS.—The House Committee on Indian Affairs have reported favorably on the bills granting this road and the Gainesville, Oklahoma & Gulf R. R. right of way through the Indian Territory.

LITTLE ROCK, SHERIDAN & SALINE RIVER.—Chartered in Arkansas to build a railway from Wrightsville to Sheridan, Ark. The officers are: Pres., Wm. Farrell, Little Rock, Ark., and V. P., R. E. Farrell.

ARKANSAS CITY, OKLAHOMA & TEXAS.—Chartered in Kansas to build a line of railway from Arkansas City, Kan., southwest to Oklahoma and Texas. T. W. Eckert, Arkansas City, Kan., is interested.

Rocky Mt. and Pacific.—Existing Roads.

REDONDO.—It is stated that this railway, from Los Angeles to Redondo, Cal., 17 miles, will be extended during the coming year.

SANTA FE SOUTHERN.—According to press dispatches, the extension of this road to San Pedro, N. Mex., is practically assured.

DENVER, LAKEWOOD & GOLDEN.—It is stated that this company has decided to push the construction of its line from Golden to Balston, Colo., 8 miles, as soon as the weather will permit.

COOS BAY, ROSEBURG & EASTERN.—The material is all on hand for completing the remaining 10 miles of this road to Coquille City, Ore. It is stated that the prospects are good that the company's bonds will be floated and the road completed to Roseburg.

CANADIAN PACIFIC.—This company will soon begin surveys for a line from Ravelstoke, B. C., to the head of Arrow Lake, 28 miles.

BURLINGTON & MISSOURI RIVER.—About 2,000 men are now at work on the extension from Gillette, Wyo., to the Powder River, 40 miles, and it is expected to have the grading completed early the coming spring.—The citizens of Greeley, Colo., propose to build a railway from that place to Idaho Creek, Colo., 16 miles. The line will be equipped and operated by this company.

PORT TOWNSEND SOUTHERN.—According to Port Townsend, Wash., papers, work will soon begin on this line between Quilicene and Butler's Cove, 60 miles.

GREAT NORTHERN.—In a recent interview Pres. J. J. Hill is quoted as saying that the Pacific Extension would be completed to Spokane, Wash., by April, and to the Columbia River, 175 miles west of Spokane, by July.

NORTHERN PACIFIC.—A press dispatch says: "The Northern Pacific Railway Co. has decided to extend its system from Washington to Vancouver City, the Pacific Coast terminus of the Canadian Pacific Ry. The line from the international boundary to the city of Vancouver, if built, will be constructed under the charter granted by the Provisional Legislature last year to the Burrard Inlet and Frazer Valley R. R. Co. It is understood that negotiations for placing a certain amount of the bonds of the company in London have been recently completed.

Projects and Surveys.

HELENA & CASTLE.—The citizens of Helena have subscribed $115,000 in aid of the proposed road from that place to Castle, Mont.

ABERDEEN & VICTORIA.—Surveys will begin at once for this proposed road from Aberdeen, Wash., to the Straits of Fuca, and it is stated that 25 miles of road will be built this year.

MT. TABOR & EASTERN.—It is reported that work is expected to begin on this proposed railway from Portland, Ore., toward the Cascade Mts. early in the spring.

ELECTRIC RAILWAYS.

SPRINGFIELD, MASS.—The street railway company has petitioned for leave to extend its tracks and electric system in two directions.

BROOKLYN, N. Y.—The Coney Island, Fort Hamilton & Brooklyn R. R. Co. has asked for a franchise to construct and operate a trolley electric railway in Fifth Ave. The company proposes to extend its route outside of the city, in New Utrecht, to Coney Island.

A rival application has been made by the Atlantic Avenue R. R. Co., which also proposes to extend its road to New Utrecht.

COHOES, N. Y.—The Troy & Lansingburg Street Ry. Co. has a project for a line connecting with the present line to Troy.

FLATLANDS, N. Y.—The Brooklyn City R. R. Co. has filed an application for permission to use steam or trolley on Flatbush Ave. in the town of Flatlands.

BALTIMORE, MD.—The Baltimore, Canton & Point Breeze Ry. Co. recently applied for a franchise. J. Vernon Campbell is one of the incorporators. The Union Passenger Ry. Co. has applied for permission to use electricity.

MARIETTA, GA.—It is reported that New York parties have signified their willingness to build an electric road from Marietta to the Chattahoochee River, provided citizens of Marietta and people along the line will contribute money and land respectively. Address Moultrie Sessions.

FORT WAYNE, IND.—The Fort Wayne Street Ry. Co. has asked for a perpetual franchise allowing it to use electricity.

MONTICELLO, ILL.—A press dispatch states that it is proposed to build an electric railway through Platt County which will connect the cities of Monticello, Bement, Deland and Atwood, making a line of road 30 miles in length, with accommodations for passengers, and with freight cars sufficient to carry the grain and produce of the adjoining farms.

OLYMPIA, WASH.—A road from Olympia to Tumwater is projected. Address George A. Shannon or E. T. Young, of the Olympia Light & Power Co.

SEATTLE, WASH.—It is reported that Fred E. Sander contemplates extending the Grant St. Electric R. R. along the Duwamish and White River valleys until it reaches Tacoma.

HAMILTON, ONT.—It is reported that the Hamilton, Beamsville & Grimsby Electric Ry. Co. wishes permission to run through the city.

WINNIPEG, MAN.—Application will be made at the next session of the Legislature for the incorporation of the Winnipeg Electric Ry. Co.

NEW COMPANIES.—Union Passenger Ry. Co., McKeesport, Pa.; $18,000; Prest., Jas. Evans. Pottsville, St. Clair & Minersville Ry. Co., Pottsville, Pa.; $100,000; Prest., W. F. Sadler.

ELEVATED AND CABLE RAILWAYS.

BROOKLYN, N. Y.—It is reported that the Kings County Elevated R. R. will be extended to the Rockaway Beach R. R. at Ozone Park, but an amendment to the company's charter must first be secured.

BALTIMORE, MD.—It is stated that the Baltimore City Passenger Railway Co. will cable its "Blue line."

NEW ORLEANS, LA.—The Council has instructed the Committee on Streets and Landings to formulate a plan for a belt railway.

HIGHWAYS.

BOWLING GREEN, O.—Petitions for macadamizing the main road from this place to Perrysburg have been gotten out. The length of this road is 12½ miles. It is proposed to improve it to a width of 20 ft., leaving a 10-ft. dirt road at one side. The depth of the macadam would be 18 ins. at the center and 14 ins. at the side. Estimated cost, including drainage, $5,000 per mile. Geo. Knass is interested.

RIDGE TOWNSHIP, VAN WERT CO., O.—A bill authorizing $100,000 in bonds for road improvements has passed one or both branches of the legislature.

OSHKOSH, WIS.—It is stated that the Business Association has ordered the construction of another road

across Lake Winnebago. It will extend from the foot of Ceape St. direct to Brotherstown.

BERCLAIR, TEX.—A committee has been appointed by the court to select and survey a new country road. It is said that the road will extend to Rayville.

WHATCOM, WASH.—A vote on the issuance of $400,000 of bonds for a system of wagon roads will be taken March 5.

BRIDGES, TUNNELS AND CANALS.

NORWICH, N. Y.—An iron bridge to cost about $3,700 is talked of at this place.

BRUSH CREEK, O.—A bill has been introduced into the Ohio State Legislature authorizing Muskingum Co. to issue $16,000 of bonds for a bridge at this place; also $30,000 of bonds for a bridge at Zanesville.

HAWKINSVILLE, Ga.—Sealed proposals will be received at the office of the county commissioners of Pulaski Co., Ga., until March 22, 1892, for removing the fixed iron highway bridge across the Ocmulgee River, Ga., and constructing in its place an iron or steel drawbridge. D. G. Fleming, clerk of the Board of Commissioners, Hawkinsville, Ga.

CHICAGO, ILL.—The West Side Park Commissioners have decided to build a bridge over the west branch of the south fork of the river at California Ave., the structure to cost about $32,600.

PORT ANDREW, WIS.—A number of meetings have been held in the town of Richwood, Dodge Co., for the purpose of raising money to build a bridge across the Wisconsin River at a point near Port Andrew. About $10,000 have already been guaranteed. It is estimated that the cost will not exceed $24,700.

WATER-WORKS.

New England.

BOOTHBAY HARBOR, ME.—It is hoped that works will be built this spring. A citizens' meeting to discuss the matter was held recently.

WISCASSET, ME.—Works are talked of.

THE WEIRS, N. H.—It is reported that construction will be started in the spring. The Weirs Water-Works Co. was chartered in 1885.

BARRE, MASS.—Citizens have petitioned for authority to form a water-works and sewerage district, according to report.

FITCHBURG, MASS.—The city has applied for authority to increase its supply and to issue $300,000 of bonds.

LYNN, MASS.—A reservoir on Hawke's Brook is proposed. Authority to issue $150,000 of bonds may be sought. The water board has been directed to confer with the Peabody authorities upon the expediency of connecting the Lynn and Peabody water supplies to provide against contingencies.

PROVINCETOWN, MASS.—The works which the town voted to build, as noted last week, are estimated to cost $65,000.

STOUGHTON, MASS.—At a coming town meeting the purchase of the works of the Stoughton Water Co. will be considered. If bought a supply from a new source, it is said, may be introduced.

Middle.

ALBANY, N. Y.—The commissioners have recommended that "a modern filtering system" be introduced.

MAYVILLE, N. Y.—The village water bonds have been sold to F. Kloeckner & Co., New York.

TICONDEROGA, N. Y.—The commissioners have adopted plans for works by S. E. Babcock, Little Falls, and an election will be held to vote on the construction of works. The system includes a 3,000,000-gallon reservoir and about 10 miles of mains. The source of supply is about two miles from the village. Estimated cost, $50,000.

YONKERS, N. Y.—According to the Yonkers "Herald" the plans for an increased water supply include an increase of 25% in the capacity of the present storage reservoir, which will necessitate the building of a dam. The plans also include the construction of a 30,000,000-gallon reservoir and the laying of new force and supply mains. Extensions to the mains at a cost of $100,000 are projected, and the other work will cost, it is estimated, $200,000. Authority to issue $300 000 of bonds has been or is to be asked.

CRANFORD, N. J.—It is reported that the Union Water Co. will lay mains in Cranford this summer.

CANONSBURG, PA.—A citizens' meeting to discuss works has been held. Alexander Speer is on a committee appointed to investigate works and report Feb. 23, it is said.

GLEN ROCK, PA.—The "Item" of this place says the town should have works.

MIFFLINTOWN AND PATTERSON, PA.—F. R. Gilbert, Prest., has offered to build gravity works, with a reservoir, and to supply water to 20 hydrants at $30 per year for ten years.

NEWMANSTOWN, PA.—A charter was granted Feb. 17 to the Newmanstown Water Co.; Treas., N. P. Coldren; Directors, Amos R. Hageman, J. L. Shultz and others; capital stock, $6,000.

NEW WILMINGTON, PA.—Works are talked of.

PHILLIPSBURG (BEAVER CO.), PA.—Agitation for works continues. According to the "Star" of Beaver, both the Valley and the Union Water Cos. are willing to supply the town. The Union Water Co. supplies Rochester and Bridgewater; Mgr., Martin Metzgar.

ROBESONIA, PA.—Works are wanted.

WESTFIELD, PA.—The project for works here is said to be alive still.

WEST PITTSTON, PA.—Borough works are projected. It seems that the People's Water Co., of Pittston, now supplies the borough.

PENSYLVANIA.—It is stated that on March 7 application will be made to the Governor by W. S. Perot, Jr., Joseph S. Keen, Jr., Francis M. Brooke, Joseph W. Hawley and George M. Bunting, for the charter of an intended corporation, to be called The Highland Water Co., of Ridley Township. It is also stated that the same men have applied for the following incorporations: The Citizens' Water Co. of Darby Borough, The People's Water Co. of Darby Township, The Consumers' Water Co. of Upper Darby, and The Tinicum Water Co.

ELKTON, MD.—It is reported that works will be built this summer.

MIDDLETOWN, MD.—D. G. Adelsberger, Baltimore, has just completed a survey of the proposed works. Estimated cost, $10,000.

Southern.

BERKELEY, VA.—It is reported that one of the citizens thinks of building works. The town also thinks of building works, as voted Feb. 6.

FRANKLIN, VA.—Address J. R. Knight regarding proposed town works.

DANVILLE, VA.—C. A. Ballou, Supt., informs us that the Council adopted the meter system by a unanimous vote, on Feb. 10, meters to be put in as rapidly as possible. Fifty meters have been ordered bought.

ATHENS, GA.—The proposed city works include a 2,000,000-gallon reservoir and two stand-pipes, it is said. Estimates have been made. Prof. C. M. Strahan and St. Comr. J. W. Barnett. J. H. Rucker, Chn., Water Com. of Council.

MANATEE, FLA.—Water-works and electric lights are projected. Address C. E. Reed.

PIEDMONT, ALA.—A contract for water and electric lighting plants has been made with George D. Harris and associates.

PLAQUEMINE, LA.—The Plaquemine Water-Works Co. has filed a charter; Prest., Joseph A. Grace; Secy., David Altemus; Supt., Chas. H. Dickinson; capital stock, $15,000.

NASHVILLE, TENN.—The Council has appropriated $20,000 for additional meters and $7,500 for a new boiler house and boilers.

North Central.

ASHTABULA, O.—A press dispatch states that the company proposes to improve the quality of the supply.

BOWLING GREEN, O.—The "Sentinel" is opposed to granting the proposed franchise to T. W. Newcomer on the ground that a more favorable contract could be made with other parties. J. H. La Farre has made detailed estimates as to the cost of works, the total of which is about $90,000, including three wells, pumps and stand-pipe.

CINCINNATI, O.—Steps are being taken to secure authority to build new works and issue $6,000,000 of bonds to pay for them.

DECATUR, IND.—Works are wanted and investigations are being made.

ADRIAN, MICH.—The Council has voted to submit to vote at the spring election on the issuance of $135,000 in bonds to buy the company's works.

WEST BAY CITY, MICH.—E. W. Donovan is said to be interested in a scheme to supply Bay City, West Bay City and Saginaw from the lake by means of one system of water-works; estimated cost, $1,500,000. Each of these cities is now supplied by public works. Bay City and West Bay City are trying to arrange for a new joint intake pipe from Saginaw Bay.

AURORA, ILL.—The city will issue $20,000 of 5% bonds for the extension of the works. Cy. Clk., J. M. Kennedy.

CHICAGO, ILL.—An extension of the old, or two-mile tunnel, is talked of.

GENEVA, ILL.—A stand-pipe may be used in connection with the proposed works.

HAMMOND, ILL.—We are informed that Remington & Co., Chicago, have contracted for a 3,000,000-gallon pump to be placed here.

MAROA, Ill.—The construction of works has been started.

OLNEY, ILL.—T. A. Hardman, Olney, has received the contract for the construction of works; price, $20,970. The Laidlaw & Dunn Co., Cincinnati, will furnish the pumping plant.

BERLIN, WIS.—Water-works and sewerage systems are projected.

MARSHFIELD, WIS.—It is reported that S. A. Souther, representing Hyde & Jackson, New York, will ask for a franchise. Five miles of pipe and 60 hydrants are proposed. The franchise calls for an annual hydrant rental of $1,000, and $70 for additional hydrants.

PHILLIPS, WIS.—Works are projected.

Northwestern.

ELTON, IA.—At the spring election the people will vote on building works.

NORTHFILD, MINN.—It is stated that water-works will be one of the main issues at the coming election. Address M. W. Skinner.

GREELEY, NEB.—The town will build works this spring.

PIERCE, NEB.—An effort to secure works is being made.

Southwestern.

COLUMBIA, MO.—Arrangements for works are being made.

PARAGOULD, ARK.—It is said that the Electric Light & Power Co. will put in water-works and an ice factory.

DALLAS, TEX.—The Council has adopted a report favoring the awarding of a contract for a 6,000,000-gallon high service and 10,000,000-gallon low service pump.

HONDO CITY, TEX.—The Hondo City Water-Works Co. has been incorporated; capital stock, $25,000.

COAL CREEK, COLO.—The Coal Creek Water & Light Co. has voted $15,000 for a pipe line from the mountains. Surveys are being made.

HARMAN, COLO.—The town will try to contract with the Citizens' Water Co., Denver, for a supply.

Pacific.

SPOKANE FALLS, WASH.—Water and municipal bonds to the amount of $1,200 000 have been sold to Farson, Leach & Co., Chicago and New York.

WALLA WALLA, WASH.—The company will lay 18, 10, 8 and 6-in mains this year. Secy., H. H. Turner.

LOS ANGELES, CAL.—W. H. Perry, Prest. Los Angeles City Water Co., states that a syndicate is ready to buy the company's works and provide one general system for the whole city, which, if the city will grant a 50-years franchise, will at the end of that period be turned over to the city free and clear of incumbrances. Or the plant would be turned over to the city any time after completion, if the city will give an indemnity against loss.

BRIGHAM CITY, UTAH.—The city has sold $27,500 of 6% water bonds at par to Blair & Co., New York.

Canada.

BOUCHERVILLE, P. Q.—Letters patent have been granted to Chas. Berger, Joseph Melancon and others allowing them to supply the village with water under the name of La Compagnie de l'Aqueduc de Boucherville; capital stock, $5,000.

ARTESIAN WELLS.

ALPENA, S. DAK.—A citizens' meeting has been held to discuss the securing of an artesian well to run a flour mill.

IRRIGATION.

WYOMING.—According to the Cheyenne "Sun," a canal to be known as the Black Fork, is projected to irrigate some 60,000 acres near Fort Bridger. It is said that the canal will be 24 miles long, from 20 to 40 ft. wide, and that there will be two reservoirs connected with it.

COLORADO.—A large irrigation storage reservoir has just been put under construction by the High Line Reservoir Co., of Denver, Colo., according to the "Republican," of that city. As reported the reservoir will be formed by a dam 4,000 ft. long and 40 ft. high, thrown across the South Platte River and the adjoining valley at the foot of the Anteres basin in South Park, some 90 miles from Denver. Water will be drawn from the storage reservoir, as needed, through the river to the headworks of the High Line Canal. Cyrus G. Richardson is President and Jas. H. Nichols Treasurer of the company.

ELSINORE, CAL.—The Jamacha Irrigation District has voted $750,000 of bonds for the purchase of water rights and reservoir sites, and for construction.

WILFORD, IDAHO.—The Fall River Irrigation Co., recently incorporated with a capital stock of $10,000, proposes to tap Fall River, Bingham Co., with a seven-mile canal.

NEW COMPANIES.—Sturgis Water Co., Sturgis, S. Dak., $75,000; to operate in Meade Co. Peshaston Ditch Co., Mission Precinct, Wash., $50,000. Leingberger Ditch Co., Grangeville, Cal., $19,000.

SEWERS.

BROOKFIELD, MASS.—Mr. A. J. Marble, Engr., of Worcester, has completed surveys and estimates for a sewerage system. The separate system is proposed, with 8 to 12-in. Akron Pipe. Chas. A. Allen is City Engineer.

NANTUCKET, MASS.—At a special meeting the town has voted to spend $50,000 for the laying of sewers along the water front.

ALBANY, N. Y.—The Board of Contracts and Apportionments asks bids until March 7 for constructing an 18-in. vitrified stoneware pipe sewer in Ontario St.

DUNKIRK, N. Y.—Bids are asked until Feb. 26 for the construction of a vitrified tile sewer in Swain St. Address F. C. Nagle, City Clerk.

HOLLEY, N. Y.—The village trustees have voted in favor of constructing sewers in four streets, and the clerk is instructed to correspond with D. D. Waldo, Engr., to obtain working plans, after which bids will be asked.

HORNELLSVILLE, N. Y.—The citizens have voted 972 to 108 in favor of an expenditure of $100,000 to construct a system of sewerage.

NIAGARA FALLS, N. Y.—A plan for the trunk sewer of the new system has been approved. W. C. Johnson, Engr., has been engaged to superintend the construction of the system.

MONTCLAIR, N. J.—Engineers Bassett and Owen have completed the map for the sewerage system. They recommend an outlet on Washington St. to connect with the main sewer at Newark Ave. in Bloomfield. The plans provide for 70 miles of pipe, to cost about $385,000.

ORANGE, N. J.—The bids which have been asked for sewer construction were asked before the mayor had approved the sewer resolutions, and this he declines to do until the $225,000 of sewer bonds voted last July have been offered for sale.

PLAINFIELD, N. J.—A committee composed of Messrs. L. W. Serrell, Geo. H. Frost and H. B. Newhall has been appointed to investigate the extent sewerage is needed and report the best method of sewage disposal and the cost of the same.

WILKINSBURG, Pa.—The citizens have decided unanimously in favor of a special election to vote on the proposition to bond the town for $130,000 for a complete sewerage system.

BALTIMORE, MD.—The council has appropriated $35,591 for the completion of the Penn St. sewer and opening of the street.

COLUMBUS, S. C.—The City Council asks the legislature for permission to issue $150,000 of bonds for the construction of a system of sewers. The engineer is preparing profiles and estimates for the proposed work.

GREENVILLE, S. C.—Mr. J. R. Laurence, Cy. Engr., is surveying for the new sewerage system. He has thus far reported estimates for 37,800 ft., of which 25,000 will be 8-in. pipe, to cost about $30,000. The city has granted $75,000 for the system. The council will ask bids until March 14 for the pipe, cement and brick to be used, and also for the construction.

MERIDIAN, MISS.—An election will be held June 24 to vote on the issuing of $75,000 of bonds for the construction of a sewerage system.

NASHVILLE, TENN.—The City Council has appropriated $22,500 for the Lick Branch outlet from Front St. to the river, also $4,750 for two other sewers.

NEWPORT, KY.—Mr. B. R. Morton, Cy. Engr., is preparing surveys and plans for a system of sewerage by districts. He says that trunk sewers will be required on three streets, including a 6-ft. one on Harris St., to cost about $30,000.

FREMONT, O.—About $125,000 worth of sewers are reported to be laid.

NORTH BALTIMORE, O.—The City Council has voted to construct sewers in Second and Third Sts.

SANDUSKY, O.—Sewer bonds for $30,000 will be issued.

YOUNGSTOWN, O.—The City Council has passed ordinances for sewers in several streets.

CRAWFORDSVILLE, IND.—The City Council has determined upon a complete system of sewerage, and a committee has been appointed to visit other cities and study the systems there in use.

INDIANAPOLIS, IND.—Mr. Rudolph Hering, of New York City, has been engaged to prepare plans for the proposed sewerage system. The estimated expense is $5,000,000.

BENTON HARBOR, MICH.—Mr. W. Sargent, of Chicago, has presented plans and specifications for a sewerage system, which have been adopted. The system will embrace 20,065 ft. of 2 to 4-ft. brick sewer and 91,300 ft. of 9 to 20-in. pipe sewer, and will be built as soon as the weather permits.

JANESVILLE, WIS.—Engineer Loweth has completed the preliminary plans for the city sewerage system.

SUPERIOR, WIS.—The drawings and plans for the extension of the Clough Ave. sewer from Third St. to Howard's Pocket have been completed. It will be built of wood on piles.

ST. LOUIS, MO.—A large storm water sewer in Forest Park is being planned, work to commence during the coming summer. The estimated cost is $15,000.

WHATCOM, WASH.—A member of the City Council states that the city will build $200,000 worth of sewers this year.

SAN LEANDRO, CAL.—It is proposed to build a main sewer to the bay. The length will be about three miles and cost $25,000.

WINNIPEG, MAN.—Clark & Connely has been awarded sewer contracts aggregating $9,190.

STREETS.

BROOKLYN, N. Y.—Bids are asked until March 1 for grading and paving two streets with granite blocks and cobble stones respectively. Address John P. Adams, Comr. Pub. Wks.

WASHINGTON, D. C.—Capt. G. J. Fiebeger has reported that the total cost of grading and improving the suburbs included by 16th and 12th Sts., Florida Ave. and Columbia road will be $67,744.

ROANOKE, VA.—The Committee on Streets has found that to pave Market Square, which contains 1,444 sq. yds., with granite blocks would cost $12,443; with rubble granite, $8,888; asphalt, $15,355; vitrified brick, $7,444. The committee recommends that vitrified brick be used, the brick to be laid on 6 ins. of cinders, with pitch to fill the joints. The committee also reports that to put down 60 miles of macadam in the city with brick sidewalks and stone crossings with catch basins and drains would cost nearly $25,900 a mile, and with asphalt and cement sidewalk, $74,000, which sums could be reduced by doing the work in large contracts.

PENSACOLA, FLA.—Mr. E. E. Saunders desires bids on about 15,000 sq. yds. of brick, asphalt, Belgian block or other pavement.

NASHVILLE, TENN.—The City Council has appropriated $50 350 for street improvements.

BELLEVUE, O.—Street improvement bonds for $15,000 will be issued.

CINCINNATI, O.—It is said that during the present year the city will spend about $2,500,000 for street improvements, the greater part of which will be used in improving the surface of various thoroughfares. The Board of Administration asks bids for grading, curbing and boulddering two streets, one each until March 1 and March 19.

DAYTON, O.—The paving contracts have been awarded as follows: Warren-Scharf Asphalt Co., of New York, 3 squares with Hayden block, $25,000; 2 with asphalt, $12,-80; Ed. Ryan, of Springfield, 3 squares with Canton pressed brick, $16,221; 10 with first-class Medina stone, $142,000; 5 with Porter re-pressed brick, $71,405; Christian Pook, of Dayton; 3 squares with Medina stone, $38,985; Funk & Coleman, of Springfield, 4 squares with Hayden blocks, $37,338. The bids were printed last week.

NEWARK, O.—The contract for paving East Main St. has been awarded to Brennan & Nutter at 93 cts. per sq. yd., Jones standard brick to be used. The contract for curbing was awarded to Geo. C. Wilson. These are local firms and were the lowest bidders.

READING, O.—The Village Council has voted to pave two streets, with stone. Jacob Griener is Mayor.

SPRINGFIELD, O.—It is expected that about two miles of paving will be done this year.

EVANSVILLE, IND.—Bids will be received until March 5 for paving with brick nine streets and two alleys. August Pfafflin is City Surveyor.

INDIANAPOLIS, IND.—The Board of Public Works has allowed estimates for asphalting on two streets, length 5,871 ft., cost $21,465, and has passed resolutions to lay asphalt on four others, length 11,165 ft. The City Engineer's estimate for asphalting Alabama St. from 7th to 14th Sts. is $19,199, and for New Jersey St., $28,128.

DETROIT, MICH.—The Street Committee has decided to pave four streets.

STREATOR, ILL.—Bids are asked until March 21 for paving Main St. with brick, about 12,288 sq. yds. Address E. L. Donaghho, City Clerk.

HANNIBAL, MO.—Mr. F. R. Lockling, City Engineer and Sewer Commissioner, sends us the lump bids received for paving Broadway with vitrified brick. The work will be for a length of 3,614 ft., and a width of 70 ft. between curbs or 28,109 sq. yds. T. J. Shea, Quincy, Ill., $57,062; J. B. Smith & Co., Chicago, Ill., $57,317; F. W. Menke, Quincy, Ill., $57,357; Beck & Glann, Toledo, O., $60,715; Rose & Reynolds, Hannibal, Mo., $63,104. The contract was awarded to T. J. Shea, the lowest bidder. He is to furnish all material, labor, etc., and have the work completed by Sept. 1.

ELECTRICAL.

GLOVERSVILLE, N. Y.—The following bids have been opened for street lighting: Gloversville Electric Co., $80 per lamp per year, or $120 for all night burning; the same for 3 years at $75 and $110; 5 years, $72 and $105. The Johnstown Electric Co, bid 23 cts. per lamp per night, or $81 per year, to burn until midnight; to burn all night, 34 cts. per lamp per night, or $124 per year.

JAMAICA, N. Y.—Supervisor Dunton suggests that the town ask bids for the electric light franchise.

ELIZABETH, N. J.—The Suburban Electric Light Co. is building a line to Roselle, Cranford and Westfield, all of which towns it is intended to light with electricity. A sub-station will be established at Westfield. The company plans to light the whole of Union County when it gets the new works in full operation.

QUAKERTOWN, PA.—The citizens have voted in favor of electric lights, and will erect a plant to cost about $22,000

DELAND, FLA.—The city has contracted with the electric light company for 17 lights at $50 per month.

HILLSBORO, O.—A plant is to be erected at a cost of $40,000.

KOKOMO, IND.—The City Council desires bids for electric lighting.

LAFAYETTE, IND.—The contract with the Brush Electric Lighting Co. has been renewed.

CENTRALIA, ILL.—The City Council has under consideration a proposition to light the city with arc lights of 2,000 c. p. at a cost of $6.50 each per month. The city is now lighted by 75 gas lamps, at a total cost of 60 cts. per month for each lamp.

CHICAGO, ILL.—The contracts for lighting Wards 5 and 6 has been awarded to the Chicago Arc Light and Power Co. at 50 cts. a night per lamp of 2,000 C. P. The Archer Electric Co. bid 45 cts. per lamp, but could only furnish 60 lamps at present.

PEIRCE CITY, MO.—The city has voted $12,000 for the erection of a plant to be owned by the city.

LEWISTON, IDAHO.—Bids are asked for arc lighting. J. M. Howe is City Clerk.

NEW COMPANIES.—Deer Lodge Electric Co., Deer Lodge, Mont., $25,000; M. I. Bielenberg, S. E. Larabie and Conrad Kahrs. Constantine Electric Co., Constantine, Mich., $6,000. Robinson Motor & Battery Co., Portland, Me., $500,000; Matthew H. Robinson and O. A. Foster, of Boston, and W. G. Langmaid, of Watertown, Mass. Siemens & Halske Electric Co. of America, Chicago, $500,000; O. W. Meysenburg, E. F. Bayley and O. H. Waldo. The Dalles Electric Telephone & Power Co., The Dalles, Ore., $40,000; G. V. Polton, H. C. Nielson and G. C. Blakeley. Springfield Electric Light Co., Springfield, Ore., $10,000. Lynchburg Edison Electric Co., Lynchburg, Va., $30,000; Peter J. Otey, R. L. Miller and Frank P. Christian. South Florida Electric Light Co., Bartow, Fla., $2,500; C. J. Seeger and F. J. Maywold. Mitchell Electric Co., St. Paul, Minn., $15,000; H. L. Bylleshy, H. C. Levis and W. Bromhall. Northern Electric Subway Co., Duluth, Minn., $100,000; N. J. Miller, C. R. Haines and R. M. Hunter. Terrebonne Electric Light Co., Montreal, Que., $12,000; R. H. Buchannan, L. R. Masson and E. S. Mathieu.

CONTRACT PRICES.

PAVING.—Galveston, Tex. The Board of Public Works has opened the following bids for street paving: E. B. Lull, Ritchie & Co., Topeka, Kan.; vitrified brick $1.73 and $2.515 per sq. yd. for 1 and 2 courses; curbing, $14 for native and $27 for vitrified brick per M.; R. C. Storrie; creosoted pine, $3.25 per sq. yd.; vitrified brick, $2.35 and $2.60; curbing, $15; J. W. Byrnes & Co., Galveston; creosoted pine, $2.30 and $3.05 for 4 and 6-in.; grading and surfacing, 10 cts. per sq. yd.; J. E. Byrne, Dallas; creosoted pine, $2.44 for 6-in.; grading and surfacing, 18 cts.; curbing, $15.50 per M. for native brick, 90 cts. per lin. ft. for stone; A. Ockander, Waco; creosoted pine, $2.275 for 6-in.; grading and surfacing, 20 cts.; curbing, $18 for native brick; W. A. Doyle & Co., Fort Smith, Ark.; vitrified brick, $2.03 and $2.42; grading and surfacing, 3 cts.; curbing, $20 for native brick; Western Paving & Supply Co., Chicago; asphaltum, including grading, $3 per sq. yd.; Barber Asphalt Co.; grading and surfacing, 15 cts.; curbing, $18 per M. for native brick; asphaltum, $3.50 with grading.

JETTY.—Galveston, Tex.—The following bids have been opened by the Board of Public Works for 40.0 ft. of trestle and 3,900 tons of rock: E. Ketchum, $14,038; I. Heffron; trestle $1.49 per lin. ft.; rock, $3.75 per ton; total, $15,221; R. M. Bennett, trestle, $3.50 rock; $3 15; total, $13,685; B. W. Kelter; trestle, $1,500; rock, $4 per ton; total, $17,100; Brantley & Loonie; trestle, $645; rock, $4.47 per ton; total, $18,078.

SAND.—Galveston, Tex.—The Board of Public Works has opened the following bids for sand: Isaac Heffron, 50 cts. per cu. yd. delivered and spread; C. J. McRae, 61½.

GRANITE BLOCKS.—Wilmington, Del.—The Board of Street and Sewer Directors has contracted with the Brandywine Granite Co for 300,000 granite blocks, at $1.45 per sq. yd. The blocks will be used in paving Maryland Ave., and the total cost is estimated at $18,000.

PIPE.—Lynn, Mass.—The Water Board has opened bids for supplling the city with 10,000 lbs. 6-in. iron pipe, 7,000 lbs. 4-in., 1,000 lbs. 3-in. and 850 lbs. 16-in. pipe. The lowest was that of R. D. Wood & Co., of Philadelphia, who bid $25.80 per ton of 2,240 lbs. This lot is but one-half the supply that the city will need.

MISCELLANEOUS.

BUILDING.—Harrisburg, Pa.—Bids will be received at the office of the Executive Commissioner until March 9 for the erection of the Pennsylvania building on the grounds of the World's Columbian Exposition, Jackson Park, Chicago. William Hasson is a member of the Building Committee.

GAS.—Newark, N. J.—The Franklin Gas Co. has been incorporated by H. E. Richards, J. D. Gallagher and W. S. Dodd, of Bloomfield, capital $100,000.

BONDS.—Duluth, Minn.—The City Comptroller will sell $200,000 of permanent improvement certificates Feb. 29.

MANUFACTURING AND TECHNICAL.

LOCOMOTIVES.—The Baldwin Locomotive Works, Philadelphia, Pa., have delivered 4 engines to the St. Louis Merchants' Bridge & Terminal Ry. Co., and have an order for 12 mogul freight engines, with cylinders 19 × 24 ins. and weighing 100,000 lbs. for the St. Louis & San Francisco. The Cooke Locomotive Works, Paterson, N. J., have an order for consolidation engines for the Louisville & Nashville.

CARS.—The Ohio Falls Car Co., of Jeffersonville, Ind. writes us that it has built 300 cars for an American firm under trust with an English finance company. As the cars bear the English company's ownership plates, a mistaken statement has been published to the effect that the cars were for an English road; among the important contracts now on hand are 25 passenger cars for the Pennsylvania lines (with privilege of increase to 50), 10 for the Chicago & Grand Trunk, 9 for the Louisville, New Albany & Chicago, 12 for the Nashville, Chattanooga & St. Louis and 10 for the Cincinnati, New Orleans & Texas Pacific; also 600 freight cars for the Cincinnati, New Orleans & Texas Pacific and 550 for the Louisville, New Albany & Chicago. The Wason Car Co., Springfield, Mass., has an order for 50 passenger cars for the New York, Lake Erie & Western. The Gilbert Car Works, Troy, N. Y., have an order for 60 passenger cars for the New York Central. The Chicago, Hurlington & Quincy will spend $1,900,000, the Atchison, Topeka & Santa Fe $2,500,000 and the Chicago, Rock Island & Pacific $2,000,000 for new equipment.

LOCOMOTIVE WORKS.—The following are the principal dimensions of the shops of the Richmond Locomotive and Machine Works, Richmond, Va. Foundry, 200 x 108 ft.; erection shop 314 x 40 ft., covered by a 15-ton traveling crane; machine shop, 65 x 196 ft.; machine shop 133 x 100 ft., carpenter shop, 65 x 120 ft.; smith shop, 195 x 64 ft.; pattern shop, 55 x 64 ft.; storeroom, 40 x 36 ft., 2 stories; office building, 40 x 64 ft., 3 stories; locomotive erecting pits, 60 x 165 ft., with pits and tracks for building 12 locomotives at once; tender shops, 41 x 70 ft.; boiler shop, 65 x 98 ft.; boiler shop, 115 x 255 ft.; marine erecting shop, 47 x 67 ft., with a 15-ton traveling crane; paint shop, 26 x 67 ft.; machinery storage house, 55 x 104 ft.; pattern storehouse, 78 x 34 ft., 3 stories; engine, boiler and dynamo rooms, 70 x 40 ft.

THE BERLIN IRON BRIDGE CO., of East Berlin, Conn., has the contract for a new boiler shop for the Dry Dock Engine Works, Detroit, Mich. The building will be 68 by 201 ft., and will be built entirely by the Berlin Co.

THE TOLEDO BRIDGE CO., of Toledo, O., has accepted an option on the plant of the Smith Bridge Co., and will take possession March 1. The new company was incorporated about a year ago, and has a capital of $100,000. The officers are as follows: President and General Manager, J. A. Huston; Vice-President, E. W. Tolerton; Secretary, E. B. Smith; Treasurer, George P. Waldorf; Superintendent, F. J. Zwelling; Engineer, H. O. Duerr.

THE PELTON WATER WHEEL CO. reports a season of great activity in its San Francisco and New York works, orders for 492 wheels having been filled during the past year, of capacities varying from 10 up to 1,200 HP., an increase in number of nearly 100 over that of the previous year. The majority of these wheels have been sent to the mining districts of the West, but large numbers have gone to Mexico, China, Japan, Australia and other foreign countries, to be used for mining, electrical and various other purposes. The company states that the success which has attended the introduction of the Pelton wheel in all parts of the world indicates that it is more fully meeting the varied requirements of such service than anything ever before introduced, as well as the fact that there is a better appreciation of the value of water powers for industrial enterprises.

THE SYRACUSE TUBE CO. has increased its floor space and capacity for the manufacture of iron poles for railway purposes, for which it has filled several large orders, and is anticipating larger business for the spring. The works have facilities for filling harried orders. Their capacity can be made as high as 700 or 800 finished poles a week, which, in addition to stock carried, is sufficient to meet the requirements of the largest contracts. The Engineering Equipment Co., of New York and Boston, has the sales agency.

FILTERS.—The Hyatt Pure Water Co., Newark, N. J., National Purifying Co., New York City, and American Filter Co., Chicago, have consolidated as the New York Filter Co., as noted elsewhere at more length. John C. Symons, Secy., 145 Broadway, New York City.

THE URIE DREDGE MFG. CO., of Kansas City, Mo., is manufacturing very successful machines for digging, washing and drying pebble phosphates. The advantage claimed for this dredge is a curved ladder which allows only one bucket to be in the material at one time. This bucket, holding 3½ cu. ft., is provided with 3 in. steel fingers so arranged as to break the material loose and deliver it in a loose, free state ready to be economically washed and handled. The machine has a capacity of about 60 cu. yds. per hour, or about 90 tons. The phosphate is washed as it comes from the buckets in a revolving screen of steel wire and is dried on shore.

THE BUCYRUS STEAM SHOVEL & DREDGE CO., of Bucyrus, O., is actively preparing to move its works and business to Milwaukee, Wis., about July 1. This company has acquired 15 acres of land in South Milwaukee, 13 acres on the Chicago & Northwestern Ry., and 2 acres on Oak Creek near the lake. They propose to double their present capacity, using the larger tract for general manufacturing purposes and the smaller one for a shipyard, in which to build dredger-hulls, scows, tugs, yachts and other small craft. The company are now building a third elevator dredger for Government use on the Muscle Shoal Canal in Tennessee, and a second elevator dredge for the New Orleans & Northeastern R.R. Co. for filling up the 26-mile trestle across Lake Pontchartrain. They are also finishing a combination suction and elevator dredge for the Plant Investment Co., at Port Tampa, Fla.; some heavy machinery for the draining of the Okefenokee Swamp, in Georgia, and what is claimed to be largest and most powerful dipper dredge in the United States, for Breymann Brothers, of Toledo, O.

COMPANIES.—National Mfg. Co., Perris, Cal.; to manufacture steel pipe, $25,000; Pres., M. Munger, National City. Cable Railway Improvement Co., San Francisco, Cal.; $500,000; John R. Folsom, J. J. Graff and F. R. Chandler. National Steel Rail, Paving & Construction Co., Newark, N. J.; $500,000. David Coolridge, of Johnstown, Pa.; Joseph N. Billings, Rochelle Park, N. J. International Nickel Mining Co., Chicago, Ill.; $5,000,000; Dewitt Stearn, H. S. Gillette and S. B. Cobb. Duncan Locomotive & Car Brake Co., East St. Louis, Ill.; $1,000,000; Charles W. Duncan and Shephard Knapp and J. F. Baumgartner.

CURRENT PRICE LIST.

RAILS.—New York: $39; old rails, $20 to $20.50 for iron and $14 to $15 for steel; girder rails, $40. Pittsburg: $30; old rails, $22 to $22.50 for iron and $16.75 to $17.50 for steel. Chicago: $31.50 to $32; old rails, $21.75 for iron and $14 for steel.

TRACK MATERIALS.—New York: steel angle bars, 1.65 to 1.75 cts.; spikes, 1.95 to 2.1 cts.; track bolts, 2.6 to 2.75 cts., with square and hexagonal nuts. Pittsburg: splice bars 1.7 to 1.8 cts. for iron or steel; iron or steel spikes, 2.15 to 2.2 cts.; iron track bolts, 2.65 cts. with square and 2.75 cts. with hexagon nuts. Chicago: splice bars, 1.85 cts. for iron and steel; spikes, 2.15 to 2.25 cts.; track bolts, 2.65 to 2.7 cts. with hexagon nuts.

PIPE.—Cast iron, $20 to $30 per ton. Wrought iron, discounts as follows, at Pittsburg: 57½ and 47½% on black and galvanized butt-welded; 67½ and 55% on black and galvanized lap-welded. Casing, 55%.

FOUNDRY PIG IRON.—New York: $14 to $17.50. Pittsburg: $14 to $15.75. Chicago; $14 to $16.

LEAD.—New York: 4.125 to 4.15 cts. Chicago: 3.95 cts. St. Louis: 3.85 cts.

STRUCTURAL MATERIAL.—New York: beams, 2.4 to 2.8 cts.; channels, 2.4 to 2.5 cts.; angles, 1.9 to 2.1 cts.; tees, 2.4 to 2.75 cts.; sheared iron plates, 1.85 to 2.25 cts.; steel plates, 1.9 to 2.1 cts. for tank, 2.15 to 2.3 cts. for shell, 2.4 to 2.65 cts. for flange, 3 to 3.25 cts. for firebox. Pittsburg: beams 2.5 cts.; channels, 2.5 cts.; angles, 1.9 to 2 cts.; tees, 2.25 to 2.35 cts.; universal iron mill plates, 1.9 to 2 cts.; sheared steel bridge plates, 1.9 to 2 cts.; refined bars, 1.75 to 1.8 cts.; steel plates, 2 to 2.05 cts. for tank, 2.1 to 2.15 cts. for shell, 2.35 to 2.4 cts. for flange, 3.75 to 4.25 cts. for firebox. Chicago: beams, 2.5 to 3. cts.; channels, 2.67 to 2.75 cts.; angles, 1.95 to 2.1 cts.; tees, 2.25 to 2.5 cts.; universal plates, 2.12½ cts.; sheared steel plates, 2.2 to 2.25 cts.; steel plates, 2 cts. for tank, 2.75 to 2.9 cts. for shell, 3 to 3.25 cts. for flange.

SEALED PROPOSALS will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until 2 o'clock p. m., on the 9th day of March, 1892, and opened immediately thereafter, for furnishing and erecting complete the hydraulic passenger elevator, including pump, tanks, piping, car, etc., required for the U. S. Post Office, Court House, etc., at Wichita, Kan., in accordance with drawings and specification, copies of which may be had on application at this office, or the office of the Custodian, at Wichita, Kan. Each proposal must be accompanied by a certified check for a sum not less than 2% of the amount of the proposal. The right is reserved to reject any or all bids and to waive any defect or informality in any bid. All proposals received after the time stated will be returned to the bidder. Proposals must be enclosed in envelopes, sealed and marked "Proposal for a Hydraulic Passenger Elevator for the U. S. Post Office, Court House, Etc., Building at Wichita, Kan.," and addressed to W. J. EDBROOKE, Supervising Architect.

Feb. 8, 1892. 7-2t

SEALED PROPOSALS WILL BE RECEIVED at the office of the Supervising Architect, Treasury Department, Washington, D. C., until 2 o'clock P. M. on the 8th day of March, 1892, and opened immediately thereafter, for all the labor and materials required for the interior finish of the U. S. Court House and Post Office Building at Birmingham, Ala., including furring, lathing, plastering, iron stairs, marble work, joinery work, tower clock, etc., in accordance with the drawings and specifications, copies of which may be had on application at this office, or the office of the Superintendent at Birmingham, Ala. Each bid must be accompanied by a certified check for a sum not less than 2% of the amount of the proposal. The right is reserved to reject any or all bids and to waive any defect or informality in any bid. All proposals received after the time stated will be returned to the bidder. Proposals must be inclosed in envelopes, sealed and marked "Proposal for the Interior Finish of the U. S. Court House and Post Office Building at Birmingham, Ala.," and addressed to W. J. EDBROOKE, Supervising Architect.

Feb. 5, 1892. 7-2t

SEALED PROPOSALS will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until 2 o'clock p. m. on the 16th day of March, 1892, and opened immediately thereafter, for all the labor and materials required and fixing in place complete the low-pressure, return circulation, steam heating and ventilating apparatus for the U. S. Court House and Post Office at Asheville, N. C., in accordance with the drawings and specification, copies of which may be had on application at this office, or the office of the Custodian at Asheville, North Carolina.

Bids will also be considered for any other system of heating and ventilating in lieu of the above, and parties proposing to supply such must submit with their proposal plans and full specification for same.

Each bid must be accompanied by a certified check for a sum not less than 2% of the amount of the proposal.

The right is reserved to reject any and all bids and to waive any defects or informality in any bid.

All proposals received after the time stated will be returned to the bidder.

Proposals must be enclosed in envelopes, sealed and marked, "Proposal for the Low Pressure, Return Circulation, Steam Heating and Ventilating Apparatus (or otherwise as the case may be) for the U. S. Court House and Post Office Building at Asheville, N. C.," and addressed to W. J. EDBROOKE, Supervising Architect.

February 17, 1892. 8-2t

Proposals for Sewerage.

Sealed bids for excavating and refilling approximately ten miles of sewer trenches. Supplying (approximately) ten miles best quality salt glazed, vitrified sewer pipe from 8 to 20 ins. internal diameter. And 500 barrels (approximately) of fresh burned fine ground Rosendale cement.

Proposals for the different materials will be inclosed in separate envelopes and addressed to the Clerk of the City of Greenville, each envelope plainly marked "Proposal for Sewer Excavations" or "Proposal for Pipe," as per contents.

Bids for trench excavations will state price per yard (cubic) for earth, hard and soft rock, and price named must cover cost of refilling the trenches as per specifications.

Bids for sewer pipe must state price per lineal foot for the different sizes delivered on cars at Greenville in good condition, also price each for specials.

Bids for cement must state price per barrel delivered in car loads as required The Sewer Committee reserves the right to reject any and all bids.

Proposals must be accompanied with a certified check for $300. Proposals not so accompanied will not be considered.

Plans and profiles may be seen and specifications and other information obtained at office of City Engineer, Room 2, Saving Bank Block.

Sewer Com. { A. G. GOWER, GEO. G. WELLS, G. D. BARR, H. T. COOK,

JAS. R. LAWRENCE, City Eng. 8-3t

UTICA PIPE FOUNDRY CO.

CAST IRON PIPE AND SPECIALS FOR WATER AND GAS.

Also Flanged Pipe and Fittings, Hydrants, Gates, Pig Lead, etc.

CHAS. MILLAR & SON, Selling Agts., Utica, N. Y

Manufacturers of Lead Pipe and Plumbers' Materials.

Wholesale Eastern Agents Akron Vitrified Sewer Pipe.

MONTAGUE & COMPANY,

MANUFACTURERS

FIRE BRICK, SEWER PIPE,

DOUBLE STRENGTH

RAILROAD CULVERT PIPE.

CHATTANOOGA, TENN.

JOHN W. HARRISON, Pres. and Treas. THOS. HOWARD, Vice-Pres.
F. B. NICHOLS, 2d Vice-Pres. E. H. QUEEN, Sec'y. P. MCARTHUR, Supt.

HOWARD-HARRISON IRON COMPANY,

MANUFACTURERS OF

CAST IRON PIPE

FOR WATER-WORKS, GAS WORKS, CULVERTS.

Pipe and Pump Connections. Flexible Joints. Heavy Loam Castings.

Works at BESSEMER, ALA. Offices at BESSEMER and ST. LOUIS.

ARTHUR KIRK & SON,

910 Duquesne Way, PITTSBURG, PA.

BLASTING POWDER, DYNAMITE, ROCK DRILLS,

MINING AND QUARRYING MACHINERY.

AIR COMPRESSORS, ROCK CRUSHERS, SAFETY FUSE, ELECTRIC BATTERIES, MINERS' SQUIBS.

TO CONTRACTORS.

When contemplating the use of material, such as Corrugated or Plain Iron Roofing, Corrugated Arches, Ceiling or Metallic Lath, you will find it to your advantage to avail yourselves of our long experience and extensive facilities for prompt shipments.

A large Galvanizing Department is one of our prominent features.

All inquiries by mail or wire receive immediate attention.

THE CINCINNATI CORRUGATING CO.,

PIQUA, O., U. S. A.

Postponed Opening of Bids.

NOTICE TO JAIL CONTRACTORS.

Notice is hereby given that sealed bids will be received by the undersigned until 12 o'clock M. on first Tuesday in April, 1892 (April 5), at Ordinary's office of Muscogee County, Georgia, for the erection and completion of a county jail for Muscogee County, Georgia. Plan and building specification can be seen at office of the Ordinary. Each bidder will be required to furnish sample of such grating and material as he proposes to bid on, said samples not to be less than 18 × 24 ins., Board retaining samples of successful bidder until completion of the work, and to furnish specification of steel and iron work, and construction of same to conform to size of cells, etc., as shown on said plan. Successful bidder will be required to give bond as the law directs, the Board reserving the right to reject any and all bids.

LOUIS F. GARRARD,
JOHN H. BASS,
WILLIAM L. TILLMAN,
County Commissioners.

7-3t

PROPOSALS FOR SWEEPING AND Cleaning Streets in the District of Columbia.—Office of the Commissioners of the District of Columbia. Washington, Jan. 23, 1892.—Sealed proposals will be received at this office until 12 o'clock m., of Tuesday, Feb. 23, 1892, for sprinkling, sweeping, and cleaning improved streets and avenues in the District of Columbia for five years from June 30, 1892, subject to annual appropriations by Congress. Blank forms of proposals and specifications can be obtained upon application therefor at this office, together with all necessary information, and bids upon these forms will alone be considered. The right is reserved to reject any and all bids or parts of bids. J. W. DOUGLASS, J. W. ROSS, W. T. ROSSELL, Commissioners, D. C. 5-6t

DREDGING IN PORT JEFFERSON INlet, N. Y. Engineer Office, U. S. Army, Room H 7, Army Building, 39 Whitehall St., New York, N. Y., Jan. 23, 1892. Sealed proposals in triplicate for dredging in Port Jefferson Inlet, N. Y., will be received at this office until twelve (12) o'clock noon on Thursday Feb 25, 1892. The attention of bidders is invited to the Acts of Congress approved Feb 26, 1885, and Feb. 23, 1887, Vol. 23, page 332 and Vol. 24, page 414, Statutes at Large. Further information can be obtained at this office. Applications should be indorsed on the envelopes, "Official Business," D. C. HOUSTON Colonel of Engineers. 5-4t

Notice to Bridge Builders.

Sealed proposals will be received at the office of the Board of Public Works of the City of Duluth, Minn., until 2 o'clock P. M. of Monday, Feb. 29, 1892, for the construction of an iron and steel viaduct on Lake Ave. of this city. Length, 684 ft.; width, 60 ft., general drawings, specifications, etc., of which may be seen at this office. No bid will be received unless accompanied by a certified check for a sum not less than 10 per cent. of the amount of the proposal, or a satisfactory bond of at least 25 per cent. of the amount of said proposal.

Bidders are requested to state what will be the maximum clear headroom beneath the 77-ft. span in case they submit an arrangement other than shown on general drawings, the aim being to acquire 20 ft. clear headroom if possible without changing the grade of the viaduct as shown.

Bids received after 2 o'clock P. M. of above day will be rejected. The Board reserves the right to reject any or all bids. Address communications to

T. W. ABELL,
Clerk Board of Public Works,
Duluth, Minn.

Dated Jan. 26, 1892. 6-4t

Drainage Pump.

COMPTROLLER'S OFFICE,
CITY OF NEW ORLEANS,
NEW ORLEANS, Nov. 20, 1891.

Sealed proposals will be received at this office until the hour of 12 M., Thursday, Feb. 18, 1892, for the construction of a new drainage pump, in accordance with plans and specifications on file in the office of the City Engineer. Copies of plans and specifications will be forwarded by mail on request. A deposit of $200 will be required to accompany each bid. The city reserves the right to reject any and all bids. All in conformity with Ordinance No. 5,753, C. S., adopted Nov. 10, 1891.

OTTO THOMAN, Comptroller. 48-13t

Commonwealth of Massachusetts.

METROPOLITAN SEWERAGE COMMISSIONERS—NOTICE TO CONTRACTORS.

Sealed bids for building sections 13 and 14 of the Metropolitan Sewerage System in Chelsea in accordance with the form of contract and specifications to be furnished by the Board of Metropolitan Sewerage Commissioners, will be received by said board at its office, 93 Lincoln St., Boston, Mass., until 12 o'clock M. of Saturday, Feb. 27, 1892.

No bid will be received unless accompanied by a certified check for the sum of $1,000.

All bids must be made upon the blank forms furnished by the board.

Some other particulars are approximately as follows:

Section.	Length, feet.	Average depth, feet.	External diameter, feet.	Cubic yards brick and other masonry.
13.	3,810	32.5	12	5,870
14.	2,500 trench.	30.2	12	4,300
	850 tunnel.	....	11	1,070

Plans can be seen and specifications and forms of contract can be obtained at the above office.

Brick must equal samples shown in the office of the Engineer.

Each bidder is required to make a statement indicating what sewer and tunnel work he has done, and to give references that will enable the board to judge of his business standing.

The board reserves the right to reject any and all bids.

Sections 13 and 14 are alternatives of each other. If a contract is made for one the bids for the other will be rejected.

HOSEA KINGMAN, TILLY HAYNES, ROBERT T. DAVIS, } Board of Metropolitan Sewerage Commissioners of Massachusetts.

HOWARD A. CARSON, Chief Engineer. 4 5t

Notice to Contractors of Granite Street Paving.

Sealed Proposals will be received by the New Orleans & Northeastern Railroad Company until 12 o'clock, noon, of March 15, 1892, for the paving of Levee or North Peters Street from Louisa to Poland Street, in the City of New Orleans, La., with granite block paving.

The amount of paving required is about ten thousand square yards.

Specifications can be obtained at the office of G. B. Nicholson, Chief Engineer, 35 West 4th Street, Cincinnati, O., or from John Glynn, Jr Resident General Agent, 34 St. Charles Street New Orleans, La.

All bids must be addressed to C. C. Harvey, Vice-President New Orleans & Northeastern Railroad Company, 35 West 4th Street, Cincinnati, O.

The company reserves the right to reject any or all bids.

C. C. HARVEY,
7-5t Vice President N. O. & N. E. R. R. Co.

Mechanicville, N. Y., Water-Works.

NOTICE TO CONTRACTORS.

SEALED PROPOSALS will be received for the entire construction of these works by the undersigned, Water Commissioners of the Village of Mechanicville, N. Y., at their office, up to 3 P. M. of Wednesday, Feb. 24, 1892, at which time they will be publicly opened.

Each proposal must be made upon the "form" furnished by the Commissioners.

The right to reject any or all bids is reserved by the Commissioners.

Each proposal must be accompanied by cash draft or certified check for five hundred dollars ($500) payable to the Treasurer of the Mechanicville Water Board, as liquidated damages for failure to execute the contract with security, approved by the Commissioners within the time named.

Quantities, specifications and other information can be obtained from the Commissioners or the Engineer.

Plans, profiles and other drawings will be on exhibition at the Commissioners' office, on and after Feb. 8, 1892.

Address all communications to WM. B. NEILSON, Clerk of the Board of Water Commissioners.

JOHN C. GREENE, Pres.
WM. B. NEILSON, Clerk.
AMOS BRYAN, THOMAS H. SLAVIN, JOHN SHEEHAN, DANIEL RYAN, ALBERT PATRICK, } Comrs.

MECHANICVILLE, N. Y., Jan. 19, 1892.
P. H. BAERMANN, Eng.,
6-3t No. 10 First St., Troy, N. Y.

STREET IMPROVEMENTS, EVANSVILLE, IND.

Notice to Contractors.

The Board of Public Works, of the city of Evansville, will receive sealed proposals at the office of the city clerk until 12 o'clock noon, Saturday, March 5th, 1892, and not thereafter, for the improvement of Vine street from the northeast line of Third street to the northeast line of Fifth street by grading, curbing and paving with brick, according to plans and specifications approved by the Common Council. Bids must be made in the manner stated in the specifications, and must be accompanied with samples of brick proposed to be used. Each bid must be accompanied with a cash deposit of Five Hundred Dollars, or a certified check for that amount drawn in favor of the city of Evansville, and deposited with the clerk. Bids to be indorsed "Proposals for Improving Vine street from Third to Fifth streets. Plan, profile, cross sections and specifications can be inspected at the office of the city surveyor or city clerk. Blank forms for "bidders" may be procured at the city clerk's office. The Board of Public Works reserves the right to reject any and all bids.

By order of the Board of Public Works.
City Clerk's Office, Feb. 8th, 1892.
8-1t J. R. FERGUSON, Clerk.

Notice to Contractors.

The Board of Public Works, of the City of Evansville, will receive sealed proposals at the office of the City Clerk until 12 o'clock noon, Saturday, March 5, 1892, and not thereafter, for the improvement of Columbia street, from the east line of Second avenue to the east line of Harriett street, by grading, curbing and paving with brick, according to plans and specifications approved by the Common Council. Bids must be made in the manner stated in the specifications, and must be accompanied with samples of brick proposed to be used. Each bid must be accompanied with a cash deposit of Five Hundred Dollars, or a certified check for that amount drawn in favor of the City of Evansville, and deposited with the Clerk. Bids to be indorsed "Proposals for Imp. Columbia street, Second avenue to Harriett street." Plan, profile, cross sections and specifications can be inspected at the office of the City Surveyor or City Clerk. Blank forms for "bidders" may be procured at the City Clerk's office. The Board of Public Works reserves the right to reject any and all bids.

By order of the Board of Public Works.
J. R. FERGUSON, Clerk.
City Clerk's Office, Feb. 8, 1892. 8-1t

Notice to Contractors.

The Board of Public Works, of the city of Evansville, will receive sealed proposals at the office of the city clerk until 12 o'clock noon, Saturday, March 5th, 1892, and not thereafter, for the improvement of Division street from the northeast line of Eighth street to the southwest line of Tenth street by grading, curbing and paving with brick, according to plans and specifications approved by the Common Council. Bids must be made in the manner stated in the specifications, and must be accompanied with samples of brick proposed to be used. Each bid must be accompanied with a cash deposit of Five Hundred Dollars, or a certified check for that amount drawn in favor of the city of Evansville, and deposited with the clerk. Bids to be indorsed "Proposals for Improving Division street from Eighth to Tenth streets. Plan, profile, cross sections and specifications can be inspected at the office of the city surveyor or city clerk. Blank forms for "bidders" may be procured at the city clerk's office. The Board of Public Works reserves the right to reject any and all bids.

By order of the Board of Public Works.
City Clerk's Office, Feb. 8th, 1892.
8-1t J. R. FERGUSON, Clerk.

Notice to Contractors.

The Board of Public Works, of the City of Evansville, will receive sealed proposals at the office of the City Clerk until 12 o'clock noon, Saturday, March 5th, 1892, and not thereafter, for the improvement of Fourth street from the northwest line of Main street to the southeast line of Division street by grading, curbing and paving with brick, according to plans and specifications approved by the Common Council. Bids must be made in the manner stated in the specifications, and must be accompanied with samples of brick proposed to be used. Each bid must be accompanied with a cash deposit of one thousand dollars, or a certified check for that amount drawn in favor of the City of Evansville, and deposited with the Clerk. Bids to be endorsed "Proposal for Improving Fourth street from Main to Division." Plan, profile, cross-sections and specifications can be inspected at the office of the City Surveyor or City Clerk. Blank forms for "bidders" may be procured at the City Clerk's office. The Board of Public Works reserves the right to reject any and all bids.

By order of the Board of Public Works,
City Clerk's Office, Feb. 8th, 1892.
8-1t J. R. FERGUSON, Clerk.

Notice to Contractors.

The Board of Public Works, of the city of Evansville, will receive sealed proposals at the office of the city clerk until 12 o'clock noon, Saturday, March 5th, 18-2, and not thereafter, for the improvement of Sycamore street from the northeast curb line of Water street to the west line of Main street by grading, curbing and paving with brick, according to plans and specifications approved by the Common Council. Bids must be made in the manner stated in the specifications, and must be accompanied with samples of brick proposed to be used. Each bid must be accompanied with a cash deposit of Five Hundred Dollars, or a certified check for that amount drawn in favor of the city of Evansville, and deposited with the clerk. Bids to be endorsed "Proposals for Improving Sycamore street from Water to Main." Plan, profile, cross sections and specifications can be inspected at the office of the city surveyor or city clerk. Blank forms for "bidders" may be procured at the city clerk's office. The Board of Public Works reserves the right to reject any and all bids.

By order of the Board of Public Works.
City Clerk's Office, Feb. 8th, 1892.
8-1t J. R. FERGUSON, Clerk.

Notice to Contractors.

The Board of Public Works, of the city of Evansville, will receive sealed proposals at the office of the city clerk until 12 o'clock noon Saturday, March 5th, 1892, and not thereafter, for the improvement of Franklin street from the east curb line of First avenue to the west line of Main street, by grading, curbing and paving with brick, according to plans and specifications approved by the Common Council. Bids must be made in the manner stated in the specifications, and must be accompanied with samples of brick proposed to be used. Each bid must be accompanied with a cash deposit of One Thousand Dollars, or a certified check for that amount drawn in favor of the city of Evansville, and deposited with the clerk. Bids to be endorsed "Proposals for Improving Franklin street from First Avenue to Main street." Plan, profile, cross sections and specifications can be inspected at the office of the city surveyor or city clerk. Blank forms for "bidders" may be procured at the city clerk's office. The Board of Public Works reserves the right to reject any and all bids.

By order of the Board of Public Works.
City Clerk's Office. Feb. 8th, 1892.
8-1t J. R. FERGUSON, Clerk.

Notice to Contractors.

The Board of Public Works of the City of Evansville will receive sealed proposals at the office of the City Clerk until 12 o'clock noon, Saturday, March 5th, 1892, and not thereafter, for the improvement of Eighth street from the southeast side of Main street to the north curb line of Washington avenue, by grading, curbing and paving with brick, according to plans and specifications approved by the Common Council. Bids must be made in the manner stated in the specifications, and must be accompanied with samples of brick proposed to be used. Each bid must be accompanied with a cash deposit of One Thousand dollars, or a certified check for that amount drawn in favor of the City of Evansville, and deposited with the Clerk. Bids to be endorsed "Proposals for Imp. Eighth street, Main to Washington avenue." Plan, profile, cross sections and specifications can be inspected at the office of the City Surveyor or City Clerk. Blank forms for "bidders" may be procured at the City Clerk's office. The Board of Public Works reserves the right to reject any and all bids. By order of the Board of Public Works.

J. R. FERGUSON, Clerk.
City Clerk's Office, Feb. 8th, 1892. 8 1t

Notice to Contractors.

The Board of Public Works of the City of Evansville will receive sealed proposals at the office of the City Clerk until 12 o'clock noon, Saturday, March 5th, 1892, and not thereafter, for the improvement of an Alley from the northwest line of Vine street to the southeast curb line of Division street between Sixth and Seventh streets, by grading, curbing and paving with brick, according to plans and specifications approved by the Common Council. Bids must be made in the manner stated in the specifications, and must be accompanied with samples of brick proposed to be used. Each bid must be accompanied with a cash deposit of Two Hundred and Fifty dollars, or a certified check for that amount drawn in favor of the City of Evansville, and deposited with the Clerk. Bids to be indorsed "Proposals for Imp. Alley from Vine to Division." Plan, profile, cross-sections and specifications can be inspected at the office of the City Surveyor or City Clerk. Blank forms for "bidders" may be procured at the City Clerk's office. The Board of Public Works reserves the right to reject any and all bids. By order of the Board of Public Works.

J. R. FERGUSON, Clerk.
City Clerk's Office, Feb. 8th, 1892. 8-1t

Notice to Contractors.

The Board of Public Works of the City of Evansville will receive sealed proposals at the office of the City Clerk until 12 o'clock noon, Saturday, March 5th, 1892, and not thereafter, for the improvement of First avenue from the northwest line of Division street to the north line of Pennsylvania street, by grading, curbing and paving with brick, according to plans and specifications approved by the Common Council. Bids must be made in the manner stated in the specifications, and must be accompanied with samples of brick proposed to be used. Each bid must be accompanied with a cash deposit of five hundred dollars, or a certified check for that amount drawn in favor of the City of Evansville, and deposited with the Clerk. Bids to be indorsed "Proposals for Imp. First avenue, Division to Pennsylvania." Plan, profile, cross-sections and specifications can be inspected at the office of the City Surveyor or City Clerk. Blank forms for "bidders" may be procured at the City Clerk's office. The Board of Public Works reserves the right to reject any and all bids. By order of the Board of Public Works.

J. R. FERGUSON, Clerk.
City Clerk's Office, Feb. 8th, 1892. 8-1t.

Notice to Contractors.

The Board of Public Works of the City of Evansville will receive sealed proposals at the office of the City Clerk until 12 o'clock noon, Saturday, March 5th, 1892, and not thereafter, for the improvement of an Alley from a point seventy-five (75) feet southeast of the southeast line of Locust street to the northwest curb line of Walnut street between Second and Third streets, by grading, curbing and paving with brick, according to plans and specifications approved by the Common Council. Bids must be made in the manner stated in the specifications, and must be accompanied with samples of brick proposed to be used. Each bid must be accompanied with a cash deposit of Two Hundred and Fifty dollars, or a certified check for that amount drawn in favor of the City of Evansville, and deposited with the Clerk. Bids to be indorsed "Proposals for Imp. Alley from 75 ft. se of the se line Locust st to Walnut between 2d & 3d." Plan, profile, cross-sections and specifications can be inspected at the office of the City Surveyor or City Clerk. Blank forms for "bidders" may be procured at the City Clerk's office. The Board of Public Works reserves the right to reject any and all bids. By order of Board of Public Works.

J. R. FERGUSON, Clerk.
City Clerk's Office, Feb. 8th, 1892. 8-1t.

Notice to Contractors.

The Board of Public Works of the City of Evansville will receive sealed proposals at the office of the City Clerk until 12 o'clock noon, Saturday, March 5th, 1892, and not thereafter, for the improvement of Columbia street from the east curb line of Fulton avenue to the east line of Third avenue, by grading, curbing and paving with brick, according to plans and specifications approved by the Common Council. Bids must be made in the manner stated in the specifications, and must be accompanied with samples of brick to be used. Each bid must be accompanied with a cash deposit of One Thousand dollars, or a certified check for that amount drawn in favor of the City of Evansville, and deposited with the Clerk. Bids to be indorsed "Proposals for Imp. of Columbia street, Fulton to Third avenue." Plan, profile, cross sections and specifications can be inspected at the office of the City Surveyor or City Clerk. Blank forms for "bidders" may be procured at the City Clerk's office. The Board of Public Works reserves the right to reject any and all bids. By order of the Board of Public Works.

J. R FERGUSON, Clerk.
City Clerk's Office, Feb. 8th, 1892. 8-1t

Notice to Contractors.

The Board of Public Works of the City of Evansville will receive sealed proposals at the office of the City Clerk until 12 o'clock noon, Saturday, March 5th, 1892, and not thereafter, for the improvement of Eighth St. from the northwest line of Main St. to the southeast line of Sycamore St., by grading, curbing and paving with brick, according to plans and specifications approved by the Common Council. Bids must be made in the manner stated in the specifications, and must be accompanied with samples of brick proposed to be used. Each bid must be accompanied with a cash deposit of One Thousand dollars, or a certified check for that amount drawn in favor of the City of Evansville, and deposited with the Clerk. Bids to be indorsed "Proposals for Imp. Eighth street, Main to Sycamore." Plan, profile, cross-sections and specifications can be inspected at the office of the City Surveyor or City Clerk. Blank forms for "bidders" may be procured at the City Clerk's office. The Board of Public Works reserves the right to reject any and all bids. By order of the Board of Public Works.

J. R. FERGUSON, Clerk.
City Clerk's Office, Feb. 8, 1892. 8-1t.

Notice to Contractors.

The Board of Public Works of the City of Evansville will receive sealed proposals at the office of the City Clerk until 12 o'clock noon, Saturday, March 5, 1892, and not thereafter, for the improvement of Columbia Street, from the east line of Third Avenue to the east line of Second Avenue, by grading, curbing, and paving with brick, according to plans and specifications approved by the Common Council. Bids must be made in the manner stated in the specifications, and must be accompanied with samples of brick proposed to be used. Each bid must be accompanied with a cash deposit of Five Hundred dollars, or a certified check for that amount drawn in favor of the City of Evansville, and deposited with the Clerk. Bids to be indorsed "Proposals for Imp. Columbia Street, from Third to Second Avenue." Plan, profile, cross-sections and specifications can be inspected at the office of the City Surveyor or City Clerk. Blank forms for "bidders" may be procured at the City Clerk's office. The Board of Public Works reserves the right to reject any and all bids. By order of the Board of Public Works,

J. R. FERGUSON, Clerk.
City Clerk's Office, Feb. 8, 1892. 8-1t

Notice to Contractors.

The Board of Public Works of the City of Evansville will receive sealed proposals at the office of the City Clerk until 12 o'clock noon, Saturday, March 5th, 189- and not thereafter, for the improvement of Division street from the northeast curb line of Third street to the northeast side of Eighth street, by grading, curbing and paving with brick, according to plans and specifications approved by the Common Council. Bids must be made in the manner stated in the specifications, and must be accompanied with samples of brick proposed to be used. Each bid must be accompanied with a cash deposit of One Thousand Dollars, or a certified check for that amount drawn in favor of the City of Evansville, and deposited with the Clerk. Bids to be indorsed "Proposals for Improving Division Street from Third to Eighth Streets." Plan, profile, cross sections and specifications can be inspected at the office of the City Surveyor or City Clerk. Blank forms for "bidders" may be procured at the City Clerk's office. The Board of Public Works reserves the right to reject any and all bids.

By order of the Board of Public Works.
J. R. FERGUSON, Clerk.
City Clerk's Office, Feb. 8th, 1892. 8-1t

Notice to Contractors.

The Board of Public Works of the City of Evansville will receive sealed proposals at the office of the City Clerk until 12 o'clock noon, Saturday, March 5th, 1892, and not thereafter, for the improvement of First Street from the northwest curbline of Locust Street to the northwest curbline of Walnut Street by grading, curbing and paving with brick, according to plans and specifications approved by the Common Council. Bids must be made in the manner stated in the specifications, and must be accompanied with samples of brick proposed to be used. Each bid must be accompanied with a cash deposit of One Thousand dollars, or a certified check for that amount drawn in favor of the City of Evansville, and deposited with the Clerk. Bids to be indorsed "Proposals for Improving First street—Locust to Walnut." Plan, profile, cross sections and specifications can be inspected at the office of the City Surveyor or City Clerk. Blank forms for "bidders" may be procured at the City Clerk's office. The Board of Public Works reserves the right to reject any and all bids.

By order of the Board of Public Works.
J. R. FERGUSON, Clerk.
City Clerk's Office, Feb. 8th, 1892. 8-1t

Notice to Contractors.

The Board of Public Works of the City of Evansville will receive sealed proposals at the office of the City Clerk until 12 o'clock noon, Saturday, March 5th, 1892, and not thereafter for the improvement of First street from the northwest curb line of Walnut street to the north curb line of Ewing street, by grading, curbing and paving with brick, according to plans and specifications approved by the Common Council. Bids must be made in the manner stated in specifications, and must be accompanied with samples of brick proposed to be used. Each bid must be accompanied with a cash deposit of Five Hundred Dollars, or a certified check for that amount, drawn in favor of the City of Evansville and deposited with the Clerk. Bids to be indorsed "Proposals for Improvement of First street—Walnut to Ewing." Plan, profile, cross sections and specifications can be inspected at the office of the City Surveyor or City Clerk. Blank forms for "bidders" may be procured at the City Clerk's office. The Board of Public Works reserves the right to reject any and all bids.

By order of the Board of Public Works.
J. R. FERGUSON, Clerk.
City Clerk's Office, Feb. 8th, 1892. 8-1t